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A
GUIDE TO THE STUDY
OF
EAR DISEASE

BY

P. M'BRIDE, M.D.

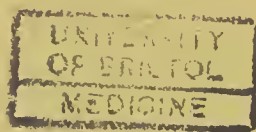
FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, EDINBURGH
FELLOW OF THE ROYAL SOCIETY OF EDINBURGH
SURGEON TO THE DEPARTMENT FOR DISEASES OF THE EAR AND THROAT IN THE
ROYAL INFIRMARY OF EDINBURGH
SURGEON TO THE EDINBURGH EAR AND THROAT DISPENSARY



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ERRATA.

Pages 42, 43, footnotes ¹ should be transposed.

Page 43, line 6 from top, for *Mysingomycosis* read 'Myringomycosis.'

„ 46, 1st line footnote, for *Neciosis* read 'Necrosis.'

„ 57, reference figure for footnote (2) should be on line below, at Urbantschitsch.

„ 64, date of Congress in footnote should be 1881.

„ 69, reference figure 1 on 1st line should be at end of 17th line from top.

„ 77, line 2 footnote, for *Caritis* read 'Carotis.'

„ 89, line 12 from top, for *rare* read 'rarely.'

„ 128, line 3 from top, for *pp. liad* read 'applied.'

„ 139, line 2 from top, for *related* read 'stated.'

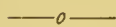
„ 151, line 6 from foot, for *Schwertze* read 'Schwartzs.'

„ 152, last line, for *or* read 'a.'

„ 189, line 3 from top, for *Zanfai* read 'Zaufal.'

„ 192, footnote 3 last line, for *apparatus* read 'Apparates.'

P R E F A C E.



IN this work I have endeavoured to meet the requirements of the student, and of the general practitioner who has not had the advantage of studying otology under the guidance of a teacher. With this object in view the text is illustrated by coloured lithographs, representing dissections and morbid conditions, while in the Appendix are figured many of the instruments commonly used in diagnosis and treatment.

It should be clearly understood that the following pages are meant merely as an introduction to the study of ear disease; but I have ventured to hope that the arrangement of the contents may render them acceptable to those for whom they are intended—viz. students and busy practitioners who have not time to peruse the larger works on the subject

In the chapters on ‘Disturbances of the Nervous System,’ ‘Tinnitus,’ ‘Diseases which involve the Organ of Hearing,’ and in the section on ‘Nervous Deafness’ (the substance of which has already appeared in the form of articles in the *British Medical Journal*, the *Medical Times and Gazette*, the *Edinburgh Medical Journal*, and the *Lancet*), I have endeavoured

PREFACE.

to supply the links which connect the work of the aurist with that of the physician. In chronic non-suppurative inflammation of the tympanum (chronic catarrh of most authors), a classification in accordance with our present clinical and pathological knowledge has been attempted.

It has been my wish throughout to avoid descriptions of numerous instruments and methods, and I have accordingly detailed those only which appear to me to meet the demands of rational therapeutics. The rarer forms of ear disease are sometimes only referred to, as also are affections of the auricle, which require for their treatment only a knowledge of general medical and surgical principles.

My thanks are due to Drs. Blaikie and Mackenzie Johnston, who kindly assisted me in revising the proofs, and to Mr. Ehlers for the accuracy with which he has executed the drawings—more especially those which represent morbid appearances of the drum-membrane.

16 CHESTER STREET, EDINBURGH,
24th Jan. 1884.

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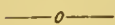
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- PLATE I. FOUR DISSECTIONS ILLUSTRATING THE ANATOMY OF THE EAR.
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COMMON USE FOR DIAGNOSIS AND TREATMENT.

GUIDE TO THE STUDY OF EAR DISEASE.



CHAPTER I.

ANATOMY AND PHYSIOLOGY.

IN a work like the present, which is only intended as an introduction to the study of otology, it will be obviously unnecessary to enter into a minute account of the anatomy of the organ of hearing, and it will suffice to refer briefly to such points as are of practical importance to the aurist.

To the structure and appearance of the auricle it is unnecessary further to allude. Its function is probably to gather and reflect sonorous waves into the meatus, the portions most concerned in this act being the concha and the fossa, of which the tragus forms the outer wall.

Of more importance to the otologist is the external auditory meatus, which is a tube, rather more than an inch in length, leading to the tympanic membrane. Its outer third is composed of cartilage, while the remaining two-thirds are of bone. The former consists of a ring of cartilage, which is defective above and behind, the space thus left being filled by fibrous tissue. In front and below, the cartilage is traversed by several transverse clefts, also filled by fibrous tissue,

and called incisuræ Santorinianæ. Just where these occur, the meatus is bounded by the parotid gland, so that it is possible for a parotid abscess to open into the external auditory canal.

The cartilaginous is united to the osseous portion by means of connective tissue. This is fortunate; for while the axis of the former runs from without inwards and upwards, that of the latter is directed downwards and forwards. It therefore follows that traction of the auricle—and with it the outer portion of the meatus—upwards and backwards will convert the canal into a straight tube, and so enable the surgeon to inspect its deeper portions, including the drum membrane.

The osseous or inner portion of the meatus presents few anatomical features of practical interest. Its anterior and inferior walls bulge more or less into the lumen of the tube, and in some individuals this is so marked, that it is well-nigh impossible to inspect the whole surface of the membrana tympani. Further inwards this convexity is succeeded by a concavity, which, with the membrane, forms a space (sinus of the external auditory canal) in which small and heavy foreign bodies may become lodged.

The most important relations of the external meatus are as follows:—

(1.) Anteriorly and inferiorly lie the parotid gland, and the temporo-maxillary articulation.

(2.) Superiorly the osseous meatus is separated from the dura mater by a double layer of bone with intervening air spaces. Sometimes, however, only a single very thin plate exists.

(3.) Posteriorly are the mastoid cells with an intervening lamella of compact bone.

The lining membrane of the external auditory canal consists of true skin, which in the cartilaginous portion

contains numerous hair follicles, sebaceous and ceruminous glands. The latter resemble sweat glands in structure, and secrete ear-wax. In the osseous portion the skin is much thinner, and almost inseparably connected with the periosteum, while, except along the upper and posterior wall, it contains no ceruminous glands. It follows that inflammation when confined to the outer third of the canal is much less serious than when the lining membrane of the osseous portion is attacked; for in this situation, owing to the intimate connection between skin and periosteum, every dermatitis is virtually a periostitis.

The principal blood supply of the meatus is derived from a branch of the internal maxillary artery. The auricular branch of the pneumogastric nerve and the auriculo-temporal from the fifth, furnish the canal with sensory fibrils. This distribution of the vagus accounts for the interesting phenomenon of ear cough, which is sometimes met with.

The external meatus is probably intended to act as a protection to the delicate tympanic membrane. The walls secrete a considerable amount of cerumen or ear-wax, which is normally expelled as it forms by the movements of the jaws, but at times accumulates in such quantity as to obstruct the passage altogether. Some of the older authors referred many cases of deafness to deficiency of wax; but we now know that, except when it collects in such quantity as to form an obstacle to the transmission of sound, the cerumen has nothing whatever to do with the act of hearing. It probably prevents the entrance of insects and small foreign bodies. The temperature of the meatus is somewhat lower than that of the rectum, but in certain acute cerebral diseases it is, according to Mendel,¹ considerably higher.

¹ *A Treatise on the Ear*, by Burnett, p. 37.

This author therefore suggested the propriety of inserting a thermometer into the ear in doubtful cases. He also found that the temperature is considerably reduced by the internal administration of chloral and opium.

The tympanic membrane (syn. drumhead, *membrana tympani*) is a delicate membrane, more or less elliptical in shape, placed obliquely across the extremity of the external auditory canal, and separating it from the cavity of the tympanum. The obliquity is from above and behind downwards and forwards, from which it follows that when the membrane is examined through the meatus, its posterior and superior parts are nearer the examining eye than the anterior and inferior. The manubrium, or handle of the malleus, is attached to the membrane, but its position will be better understood when we come to discuss the appearance of the drumhead in the living subject. Histologically, the latter consists of three parts, viz.— (1) A dermoid layer, composed of very delicate skin, continuous with that lining the meatus. (2) A layer of modified connective tissue, spoken of as the *substantia propria*, consisting of external radiating and internal circular fibres, some of which pass external to the handle of the malleus, while others are attached to it. This middle layer of the membrane is fixed to a ring of bone, which is defective above. This defect is filled up in the recent state by a portion of the drumhead, which contains no *substantia propria*, consisting of skin and mucous membrane only (*Shrapnell's membrane* or *membrana flaccida*). (3) The inner layer is composed of mucous membrane, continuous with that lining the tympanum. Posteriorly it is reflected round the *chorda tympani* nerve, and forms what has been called by Von Tröltzsch the posterior

pocket. A similar reflection anteriorly is sometimes spoken of as the anterior pocket.

The outer surface of the membrane receives its blood supply from the deep auricular branch of the internal maxillary artery, a twig from which runs just behind and parallel to the manubrium mallei. If the drumhead be slightly hyperæmic, this vessel can be well seen in the living subject. The internal or mucous layer is supplied with a fine network from the tympanic vessels.

The nerve supply of the outer or dermoid layer is furnished by a branch of the fifth nerve which runs with the artery, while the mucous membrane is supplied from the tympanic plexus.

The tympanum is a six-sided cavity. In height¹ and width it measures about half an inch, while its depth from within outwards varies from one to two lines. The roof is formed by a thin plate of bone which is occasionally defective, leaving a foramen, in which case the lining membrane is directly in contact with the dura mater.

The outer wall consists to a great extent of the tympanic membrane, but a ring of bone also enters into its formation, from which it follows that even in cases where the entire membrane has been destroyed, many parts of the cavity cannot be inspected (Plate I. C).

The inner wall is of great importance to aural surgeons, and presents for examination the following points:—(1) The fenestra ovalis; (2) the fenestra rotunda; (3) the promontory; (4) the ridge of the aqueductus Fallopii; (5) the pyramid (Plate I. D).

The fenestra ovalis is a reniform opening lying at the upper and posterior part of the inner wall. Its long axis is almost horizontal, or slightly inclined from behind

¹ Burnett, *loc. cit.* p. 79.

upwards and forwards. In the macerated bone there is an opening between the tympanum and vestibule, but in the recent state it is closed by the lining membrane of these cavities and by the base of the stapes.

The fenestra rotunda is situated at the bottom of a deep and narrow niche, and lies below, and a little behind the fenestra ovalis. The fenestra rotunda is closed by a membrane (the *membrana tympani secundaria*), and leads to the *scala tympani* of the cochlea.

The promontory, a smooth projection of bone situated in front of the fenestræ, is grooved by passages for the tympanic nerves, and contains the first turn of the cochlea.

Just above the fenestra ovalis is a slight elevation. This is the osseous wall of the aqueductus Fallopii, in which the facial nerve is contained. Running for a short distance parallel to the long axis of the oval window, the nerve takes a sudden turn and courses along the posterior wall of the tympanum towards its exit at the stylo-mastoid foramen.

Immediately behind the fenestra ovalis is a minute pyramid pierced by a well-marked aperture leading to a canal, from the walls of which arises the stapedius muscle.

The floor of the tympanum is a thin plate of bone, which separates the cavity from the jugular vein.

The anterior wall is in close relation with the carotid artery, and presents at its internal part the opening of the Eustachian tube situated at some distance above the floor.

The posterior wall separates the cavity of the tympanum from the mastoid cells, and exhibits near the roof an orifice—the opening into the mastoid cells.

The contents of the tympanum include the auditory ossicles with their ligaments and muscles. The chorda

tympani nerve also runs through the cavity at about the level of the upper margin of the tympanic membrane, passing in its course between the malleus and incus.

The auditory ossicles are three in number, and are named from their shapes—(1) The malleus or hammer ; (2) the incus or anvil, also called the *ambos* in German text-books ; (3) the stapes or stirrup.

The malleus consists of a handle or manubrium, two processes, a neck and a head. The manubrium is attached in its whole length to the tympanic membrane, and runs from above downwards and backwards to below the centre of the drumhead. At its upper part is the short process, which is also attached to the membrane. The long process extends from the junction of the handle and neck towards the Glasserian fissure. The neck and head (which presents posteriorly an elliptical depression for articulation with the incus) lie above the upper border of the tympanic membrane (Plate I. B).

The incus is situated behind the malleus, and presents a body and two processes. On the head we find an articular surface for articulation with the malleus. Of the two processes, the shorter projects backwards and is attached by fibrous tissue to the posterior wall of the tympanum ; while the longer passes downwards to articulate with the head of the stapes.

The stapes or stirrup consists of a head, neck, two crura, and a footplate. The head articulates with the long process of the incus, the neck receives the insertion of the stapedius muscle, and the crura diverge to be inserted into the footplate. The latter is attached to the margins of the fenestra ovalis, while the periosteum of the labyrinth is continued over its inner surface.

Of the articulations between the auditory ossicles not much need be said. The incus by its short process is fastened rather firmly to the posterior tympanic wall,

but it is yet capable of movement. The articulation between the malleus and incus is of such a kind that if the handle of the former move inwards, the latter will participate in the movement, and again act on the stapes; but, on the other hand, if the handle move outwards, the incus is slightly or not at all affected.

The long process of the incus in the recent state presents a convex cartilaginous surface, which corresponds to a concavity on the head of the stapes.¹ A capsular ligament keeps the two in apposition.

The malleus is held in position by three ligaments—an anterior, a superior, and an external, which are attached to the head and neck of the bone. The stapes is attached by its footplate to the membrane of the oval window, which is also the periosteum of the labyrinth, and its circumference is united to the margins of the fenestra ovalis through the intervention of cartilage and fibrous tissue (the annular ligament). A ligament of variable length connects the incus with the roof of the tympanum.

There are two intrinsic muscles of the tympanum whose functions are connected with the movements of the ossicles.

The tensor tympani runs in a canal situated above the bony portion of the Eustachian tube, and separated from it by a lamella of bone. The muscle arises from the walls of its osseous sheath and adjacent parts, and on reaching the tympanum twists round a hook-like bony prominence (the processus cochleariformis), and then crosses the tympanum from within outwards to be inserted into the malleus. The action of the muscle is to draw this bone, and with it the tympanic membrane, inwards (Plate I. B).

The stapedius muscle arises in the canal, the orifice

¹ Politzer, *Lehrbuch der Ohrenheilkunde*, p. 43.

of which is situated in the pyramid. It passes forwards to be inserted into the neck of the stapes.

The mucous membrane lining the tympanum is very delicate and intimately connected with the bone, so intimately indeed that it fulfils the function both of mucous membrane and periosteum. The epithelium is ciliated, with the exception of that covering the internal layer of the drumhead, the ossicles, and tensor tympani. Some tubular glands, and a few showing a higher structure, are found towards the orifice of the Eustachian tube.

The tympanum derives its blood supply from various sources, viz. the middle meningeal, the stylo-mastoid, the ascending pharyngeal, and the internal carotid arteries. The nerves which supply the mucous membrane are derived from the tympanic plexus. The latter is made up by the union of Jacobson's nerve (a branch of the glosso-pharyngeal) with branches from the otic ganglion and the sympathetic plexus of the carotid. The tensor tympani receives its nerve supply from the internal pterygoid branch of the fifth, and the stapedius receives a twig from the seventh nerve.

The mastoid process is situated behind the external auditory canal and tympanum (Plate I. A). It is usually composed of a tolerably dense osseous shell containing a number of spaces separated by lamellæ of bone. It is customary to speak of a vertical and horizontal portion. The latter consists, as a rule, of one very large cell situated above and behind the tympanum, with which it communicates directly. This large cell is often called the mastoid antrum, and communicates with the smaller cells which form the vertical part. The whole system is lined by mucous membrane with flat epithelium. Directly above the mastoid process in the recent state lies the lateral sinus, imbedded in a deep groove. The

mucous membrane derives its nerves from the tympanic plexus, and the stylo-mastoid artery furnishes the blood supply.

The Eustachian tube is a canal composed partly of bone and partly of cartilage and fibrous tissue, and unites the cavity of the tympanum with the pharynx. The osseous portion is about half an inch long, beginning in the anterior wall of the tympanum, and extending downwards and forwards. The cartilaginous portion is about an inch in length, and extends from the osseous part, to which it is firmly attached, to the pharynx, where it ends in a trumpet-shaped opening almost on a level with the inferior meatus of the nose. This portion of the tube is formed by cartilage internally, superiorly, and to some extent externally, the remainder being membranous. This arrangement results from the fact that the cartilage is hook-shaped on transverse section. The whole tube is lined by mucous membrane, which is ciliated, and glands are found in considerable numbers towards the pharynx.

There are three muscles which act especially upon the Eustachian tube :—

(1.) The dilator tubæ or tensor palati mollis arises among other parts from the tip of the free edge of the cartilage of the tube, and passing round the hamular process of the sphenoid goes to the soft palate. Whenever this muscle contracts it pulls the cartilaginous lip outwards, and so causes the tube to gape.

(2.) The levator palati lies below the tube, and by its contractions pushes up the floor, so tending to widen its calibre.

(3.) The salpingo pharyngeus is a delicate muscular band which connects the posterior wall of the cartilaginous part of the tube to the pharynx. Its

tendency is to pull the former backwards, and to render the canal more pervious.

The blood-vessels of the Eustachian tube are—(1) the internal maxillary, (2) the ascending pharyngeal, and (3) branches of the internal carotid. The nerve supply is derived as follows:—(1) The internal pterygoid branch of the third division of the fifth supplies the dilator tubæ; (2) a branch of the second division of the fifth sends branches towards the pharyngeal orifice; (3) the glosso-pharyngeal supplies the mucous membrane; and (4) the facial nerve through the vidian supplies the levator palati.

So far we have considered the anatomy of the external and middle ear; we must now allude very shortly and in a very general manner to the labyrinth. Its complicated structure, and the fact that it is inaccessible for purposes of treatment, alike render it unnecessary and undesirable in a work such as this to enter into anatomical details. It consists of a system of sacs and tubes, membranous in structure, which bear in their interior the delicate terminations of the auditory nerve. The former are contained in a bony case, filled with a fluid termed endolymph, and are surrounded by perilymph. The anterior part of this system is termed the cochlea, while the semicircular canals occupy the posterior. The space between them is occupied by two membranous bags, the anterior of which communicates with the duct of the cochlea, and is termed the saccule, while the posterior or utricle is connected with the three semicircular canals.

That part of the labyrinth which is most concerned in the act of hearing, and especially in the perception of musical tones, is the cochlea. It is now very generally believed that the various parts of the basilar membrane correspond to different notes. As its breadth increases

from the base of the cochlea to the apex, it has, moreover, been suggested that high tones are perceived in the former situation, while lower notes cause vibration of those parts of the basilar membrane which are nearer the apex. This view has received confirmation from a case observed by Moos¹ and Steinbrügge. Their patient heard low notes only in the right ear, and upon pathological examination it was found that there was atrophy of the auditory nerve in the first turn of the cochlea. The functions of the saccule and utricle are not yet clearly understood. Whether the semicircular canals have anything to do with the act of hearing is still open to doubt; that they are, however, the peripheral organs of a centre which is intimately connected with equilibration, is extremely probable. We know that irritation of the canals in the lower animals produces vertiginous movements, the rotation being in the direction of the canal acted upon. Lesions of the semicircular canals, we may say, are usually followed by vertigo, vomiting, and faintness in the human subject, the severity of the symptoms being probably regulated by the amount of the lesion and the stability of the nerve centres.

Our next consideration is the method by which sound is ordinarily conducted to the auditory nerve, or rather we should say, to that portion of the auditory nerve which supplies the cochlea. When a sonorous vibration strikes the tympanic membrane, it causes the latter to vibrate, and with it the malleus. The malleus moves the incus, and the incus again acts upon the stapes. This little bone is fixed to the membrane of the oval window, which moves with it. Inside of the fenestra, separated from the footplate only by

¹ 'Nerve atrophy in the first cochlear convolution,' *Archives of Otolaryngology*, vol. x.

membrane, is the perilymphatic space filled with fluid (perilymph). The movement of the stapes produces undulations of the perilymph, which react upon the membranous labyrinth and through it upon the endolymph, which bathes the delicate hair-like terminal organs of the auditory nerve. Probably at each inward motion of the stapes a corresponding outward motion of the membrane of the round window occurs, and *vice versa*.

The function of the mastoid cells is unimportant, as they may be replaced by solid bone or diploë without producing any symptoms by which this condition can be recognised.

The Eustachian tube acts as a ventilator of the tympanic cavity, and also drains away mucus from the drum, the motion of its cilia being towards the pharynx. If the tube be obstructed and air denied admission to the middle ear, deafness is produced by the inward displacement of the tympanic membrane and auditory ossicles, caused by the pressure of the external atmosphere. Illustrations of the foregoing points in anatomy will be found on Plate I. The drawings are full-sized studies of dissections in the possession of the author.

CHAPTER II.

PHYSICAL EXAMINATION OF THE EAR.

IN this chapter it is proposed to consider the various methods of examination at the command of the surgeon who desires to investigate cases of ear disease.

His first object is to ascertain to what extent the hearing power is impaired. For this purpose an ordinary watch will be found satisfactory in the great majority of cases, so it is unnecessary to enter into a consideration of the various other methods and instruments which have been suggested. The watch, however, should be tried first on a number of persons whose hearing is good, so as to establish a standard for comparison, which is obtained by taking the average distance at which the tick is heard. In examining a patient we should begin with the watch at a considerable distance from the ear, gradually bringing it nearer until the tick is perceived. The distance is then measured, and the result expressed in a fraction, of which the patient's hearing distance is the numerator, and the distance at which the watch ought to be heard the denominator. Thus, if a patient hears a watch only at a distance of two inches which should be heard at thirty, the hearing is said to be $\frac{2}{30}$ in the ear tested. In every case it is advisable to examine both ears, as unilateral deafness is rare. We all possess a very large amount of supplementary hearing,

and it is a noteworthy fact that persons with the hearing power in both ears at $\frac{1}{30}$ or thereabout, do not as a rule consider themselves in the least deaf.

Having satisfied ourselves as to the capability of hearing the watch, and having taken a note of the result, we next proceed to test the hearing power for conversation. If it be desired to examine one ear only, of course the patient must be directed to close the other with his finger, which should be slightly moistened, so that it may act as a more efficient stopper. Many people who have been deaf for a long time acquire the art of lip reading to such an extent that without hearing a sound they can repeat the words of a speaker, provided they see his face, and his lips be not concealed by hair. To obviate this possible source of error, the surgeon should either stand behind the patient or direct him to close his eyes. It is also necessary to bear in mind that vowel sounds are much more easily heard than consonants. The patient being placed at one end of the room, and facing the wall, is directed to repeat every word as soon as he hears it. The surgeon then goes to the other end of the apartment, whispers a word, coming gradually nearer till it is heard and repeated. This gives the hearing distance for whispered speech. Of course one often meets with patients who cannot hear a whisper at all; words spoken in an ordinary tone must then be used in the same manner, and the hearing distance for ordinary conversation discovered. This failing, it must be noted that the patient requires a raised voice at so many feet. By the means which have been described we are enabled to form a tolerably accurate idea of the amount of deafness present.

Our next object is to find out, if possible, the condition of the auditory nerve. If a vibrating tuning-

fork be applied to the middle line of the head, either on the brow, the teeth, or lower jaw, it is normally heard in both ears with equal intensity. The manner in which the sonorous vibrations are perceived when the stem is placed upon the bones of the head, is not the same as when the fork is held at some distance from the ear and so heard. In the latter case the waves of sound impinge upon the tympanic membrane, causing it to vibrate, and with it the whole chain of ossicles, including the stapes, which communicates the motion to the fluids of the labyrinth, thus acting upon the expansions of the auditory nerve. On the other hand, by placing the stem of the fork on the cranial bones, the vibrations are, to a great extent, conducted directly to the labyrinth, without the intervention of the meatus or tympanum.

If, then, the tuning-fork be heard well when placed upon the cranial bones, we are entitled to conclude that the sound-perceiving apparatus is acting, and if deafness be present, that it is due to some lesion in the external or middle ear. In cases where the fault lies in the sound-conducting apparatus, not only is the sound of the vibrating-fork heard well in the affected ear, but is actually heard louder than if the ear were healthy. This fact is best explained for clinical purposes by the hypothesis that the same obstruction in the sound-conducting apparatus which prevents vibrations reaching the labyrinth from the air, also prevents those which have reached it through the cranial bones from escaping, and thus they become intensified. Whether the physics of this explanation are faultless in all cases is doubted by some, but the idea originated with a very excellent physicist, Mach.¹ If a person with good hearing place a vibrating tuning-

¹ *A Treatise on the Diseases of the Ear*, by St. John Roosa, 4th ed. p. 73.

fork on the middle line of the head, the sound is perceived equally in both ears; but if one ear be stopped with the finger, the sound is greatly intensified in the obstructed ear. In a patient whose hearing is worse on one side than the other, and who hears the vibrating tuning-fork from the middle line of the head best in the deafer ear, we may assume the lesion to be in the sound-conducting apparatus. If it be heard best in the good ear, we are at any rate justified in suspecting a primary or secondary affection of the labyrinth or auditory nerve.

If, then, the tuning-fork be heard better in the defective ear, we are tolerably safe in pronouncing the labyrinth to be intact; but the converse is liable to certain exceptions. Thus, after the age of fifty, it is not at all uncommon to find the power of hearing sounds by bone conduction much diminished; this is usually assumed to be the result of changes in the bone, rendering it a less efficient conductor of sound. Politzer,¹ however, points out that it is due to senile changes in the auditory nerve. It is also probable that pressure exerted on the fenestræ and through them on the intra-labyrinthine fluid—as often occurs in chronic and acute inflammations of the tympanum—may prevent the vibrations from being perceived. Acute middle ear inflammation may also cause congestion of the labyrinth, and produce a similar result. Some of these conditions we may with propriety call functional diseases of the labyrinth.

Although it is in many cases easy, by means of the tuning-fork test, to exclude labyrinthine mischief, still we often meet with doubtful cases, where it is difficult to come to a positive decision. A method which may sometimes prove useful, is to make the patient raise his hand when he ceases to hear the sound. The

¹ *Lehrbuch der Ohrenheilkunde*, vol. i. p. 203.

surgeon then places the fork on the head of a person with good hearing, and notes whether it is still audible. Another method which has been used in doubtful cases is to stop up the ear, in order to observe whether the sound is thus intensified ; but I fail to see the advantage of this. Mr. Gardiner Brown,¹ of London, employed as his standard the length of time the vibrations can be felt by the fingers of the surgeon holding the stem ; but as presumably some persons are possessed of more tactile sensibility than others, there is here a source of fallacy.

Having ascertained the amount of deafness, and as far as possible the condition of the auditory nerve, the surgeon next proceeds to inspect the external auditory meatus and outer surface of the tympanic membrane. For this purpose the older aurists, such as Toynbee and Wilde, used direct light, supplied either by sun or lamp ; but to Von Tröltzsch we are indebted for the very perfect method of examination now at our command, which consists in using light reflected from a concave mirror, perforated in the centre, and having a focal distance of four or five inches. For ordinary purposes the mirror is furnished with a handle (Appendix, Plate I.), but it should be so made that it can be attached to a forehead-band, thus leaving both hands free to operate (Appendix, Plate I.). For illuminating purposes we may use either reflected sunlight (which gives a capital though somewhat dazzling light), lamplight, or ordinary daylight, which is the most convenient. In cases of emergency a wax candle will answer the purpose fairly well.

The patient should be seated between the surgeon and the source of light, with the affected ear towards the examiner. He must then be directed to bend his head towards the light, while the surgeon grasps the auricle with the disengaged hand and draws it

¹ *Transactions of the International Medical Congress*, 1881, vol. iii.

backwards and upwards, so as to straighten the tube of the meatus. With the mirror which occupies the other hand light is then thrown into the auditory canal, and he is enabled to examine its outer portion and ascertain what size of speculum it will admit. To see the deeper portions of the meatus, a speculum made of either metal (Appendix, Plate III. B) or vulcanite is used. Having chosen a speculum of suitable calibre, the instrument should be held between the index finger and thumb, while the auricle is taken between the ring and middle fingers of the same hand and drawn upwards and backwards. The speculum is then gently insinuated down to the beginning of the osseous meatus while light is reflected into it. Not unfrequently the view of the deeper parts of the canal is obstructed by the presence of flakes of wax; but these may be removed with angular forceps if small (Appendix, Plate III. C), or with a syringe if preferred. In the former case the forehead mirror must be used so that the hand may be guided by the eye; but where large masses of wax are present, syringing is the only proper way of removing them. Occasionally, as we shall see in a later chapter, exceptional and insuperable obstacles are met with, obstructing the view of the tympanic membrane; but assuming the canal to be unobstructed, we gain by means of reflected light and the speculum a view of the whole of the osseous meatus, and stretching across it the tympanic membrane, which we shall now proceed to consider. Its colour in the healthy ear is a very delicate bluish grey, and running from above downwards and backwards is seen the handle of the malleus. Below the lower end of the manubrium mallei a faint yellow tinge is occasionally communicated from the mucous membrane covering the internal wall of the tympanum. If the drumhead be very

transparent, its colour may be modified at certain parts by objects behind it. For the sake of description it is usual to divide the membrane into four quadrants, viz. anterior (superior and inferior) and posterior (superior and inferior.) In the posterior superior quadrant, running for a short distance parallel to the manubrium mallei, is occasionally seen the long process of the incus. In the same region may sometimes be noticed an opacity formed by the lower edge of the posterior pocket and the chorda tympani nerve. In rare cases a dark patch is visible in the posterior inferior quadrant produced by the niche of the fenestra rotunda. All these objects—the long process of the incus, chorda tympani, and niche of the fenestra rotunda—are, however, only seen where the membrane is abnormally transparent.

In examining the membrane it must always be borne in mind that it is not stretched straight across the meatus, but lies obliquely. As a result, the posterior part of its surface is much nearer the eye than the anterior, and the superior rather nearer than the inferior. We must now turn to a consideration of the most important landmarks to be sought on its surface. Running from above downwards and backwards to a little below the centre of the membrane is seen the handle of the malleus in the form of a ridge of bone slightly flattened at its lower end. At its upper extremity is a small prominence—the short process. Extending backwards and forwards from the short process to the circumference are two slight folds,—the anterior and posterior,—which although but slightly marked in health, may yet become very prominent when the Eustachian tube is obstructed. The portion of the membrane above the folds is called Shrapnell's membrane or the membrana

flaccida, and consists of only the dermoid and mucous layers. In examining the normal membrane (Plate IV.) its surface will be seen to have a delicately polished appearance, but besides, at its anterior inferior part there is a triangular shining spot having its apex at the extremity of the handle of the malleus and its base at the periphery of the membrane. The apex of the triangle points backwards and upwards. This is a purely physical phenomenon, and is probably due to the glistening surface and oblique position of the membrane, together with the concavity of its central part, brought about by the traction of the malleus and the effect of the combination of radiating and circular fibres, which make up the substantia propria. From what has been said it will be evident that changes in the bright spot indicate physical changes in the membrane, affecting either its polish or its position. At the same time very great importance should not be attached to such changes unless associated with other evidence of disease. Occasionally bright spots appear in other situations, as for instance in the posterior superior quadrant.

After inspecting the membrane it may be desirable to ascertain whether it is freely movable, and this object we may effect in various ways.

(1.) If the Eustachian tubes be pervious, the patient may be directed to hold his nose, shut his mouth, and expire forcibly. This is called Valsalva's experiment, and by it air is forced into the middle ear, driving the tympanic membrane outwards. If the latter be bound down at any part by adhesions, of course these will impede its motion. Valsalva's experiment is also often used as a means of treatment, and its advantages in this respect depend only upon the fact that it does not necessitate constant visits to the surgeon. Its disad-

vantages are that the patient may repeat the inflation too frequently, and cause relaxation of the drumhead; and it is urged by some that it is objectionable on account of its tendency to cause temporary congestion of the vessels of the head. The former objection can be guarded against by explicit directions, and the latter is perhaps more theoretical than practical.

(2.) While the surgeon is examining the ear, air may be forced through the Eustachian tubes by one of the methods about to be described. This, however, requires the presence of a practised assistant.

(3.) By using Siegle's Pneumatic Speculum (Appendix, Plate II. F, G), the membrane may be caused to move in and out, and in this way its mobility can be tested. This instrument is usually made of vulcanite, the outer end being covered by a glass plate. It is arranged so that ear-pieces of varying calibre may be used. Within the glass plate a tube branches off, and to this is attached a small india-rubber bag. When using the instrument an ear-piece is chosen which is suitable to the size of the meatus, and this is introduced so as to fit as nearly air-tight as possible into the canal. The membrane is then brought into view, and by applying intermittent pressure to the bag it is caused to move in and out, the surgeon being thus enabled to form an opinion as to its mobility and the existence of adhesions.

The methods which are used for driving air into the tympanic cavity are not merely important as aids in diagnosis, but afford most valuable assistance in the treatment of a large number of cases. While air is being forced into the tympanum by any of the methods about to be described, the ear of the surgeon should be connected with that of the patient by means of a flexible india-rubber tube having an ear-piece at either end (Appendix, Plate II. D), which thus enables him to hear

the air as it passes into the tympanum and strikes against the membrane. Modifications of the sound produced by diseased conditions will be alluded to afterwards.

(1.) Valsalva's method we have already considered, and does not require further allusion.

(2.) Politzer's method. Formerly, when air could not be forced into the middle ear by Valsalva's method, the Eustachian catheter had to be resorted to. Politzer has, however, supplied us with an excellent substitute. The patient is directed to take a mouthful of water and retain it till told to swallow. The nose-piece of a Politzer's air-bag (Appendix, Plate II. B and C) is then inserted into one nostril, the unoccupied portion of which—together with the opposite nostril—must be tightly closed by the index finger and thumb. The signal is now given to swallow, and at the same moment the bag is forcibly compressed. The result is that, unless the obstruction in the Eustachian tubes be very great, air is driven through them into the middle ear. During the act of swallowing the soft palate is raised, shutting off the superior portion of the pharynx from the inferior, while at the same time the muscles which act upon the Eustachian tube contract, and increase its lumen, so that air which is blown into the nostril by the method described naturally tends to travel into the tympanum, all other outlets being cut off. During a successful inflation the current of air is heard to strike the membrane distinctly, but for purposes of auscultation alone the Eustachian catheter is much to be preferred. In persons who have arrived at the years of discretion we can also ascertain whether air has entered the middle ear from the sensations experienced, for, as a rule, a distinct opening up of the ears is felt, with a distension of the membrane. Inspection of the latter after a successful inflation usually reveals considerable

injection of its blood vessels, which soon passes off. Several modifications of Politzer's method have been introduced. For example, Gruber, instead of making his patients swallow, directs them to say 'Huek.' By this means the soft palate is raised, as in swallowing, but the action of the palate muscles on the Eustachian tubes is less energetic. Again, Lucæ has suggested the phonation of vowel sounds as a substitute for swallowing, and thus only a partial shutting off of the superior part of the pharynx without opening of the Eustachian tubes is produced. Another excellent method is that suggested by Holt,¹ which consists in puffing out the cheeks. As the action is noiseless, auscultation during this process may yield satisfactory results. To sum up, if we desire to inflate the tympana with considerable force, or to overcome an obstinate obstruction, swallowing water, as suggested by Politzer, is to be preferred, while the other methods are suitable when it is desired to act less forcibly upon the middle ear. In very young children we cannot easily make use of any of these methods, but fortunately the act of crying is an excellent substitute for vowel phonation.

(3.) The Eustachian catheter (Appendix, Plate II. E) is a tube, made of either hard rubber or silver, with a curve at one end and a wide opening at the other for the insertion of the nozzle of the air-bag. This end is also furnished with a ring, which is merely a guide to the direction of the curved end after that portion of the instrument is out of sight. The object of the operator when introducing the catheter is to direct it so that the curved extremity is inserted into the pharyngeal orifice of the Eustachian tube.

On examining a properly prepared section of the head, it will be seen that the Eustachian tube opens into

¹ Pomeroy, *Diseases of the Ear*, p. 182.

the lateral pharyngeal wall at about the level of the inferior turbinated bone. Anteriorly and inferiorly it is bounded by a very slight membranous elevation, but behind and above its margin is formed by a more or less well-marked ridge of cartilage (Plate III.). In order to accomplish the introduction of the catheter, the instrument must be passed through the inferior meatus of the nose. The patient should be seated facing the light; the ear about to be operated on must now be connected with that of the surgeon by means of an auscultating tube, while the air-bag is held under the left arm, both hands being thus at liberty. The fingers of the left hand are placed on the patient's forehead, and the thumb on the point of the nose, pushing it slightly upwards. The catheter is then introduced along the inferior nasal passage, point downwards. It is very important to direct the instrument along the floor of this canal, otherwise it may get into the middle meatus. Having once entered the proper passage, little difficulty is generally experienced in pushing it onwards until the posterior wall of the pharynx is reached, but force should never be used. If the instrument at first introduced be too large, a smaller one should be tried. Having pushed the catheter in so that its beak is directed downwards and in contact with the posterior wall of the pharynx, one of three methods may be next adopted to make the point enter the trumpet-shaped pharyngeal orifice of the Eustachian tube.

(1.) The simplest plan, and one which is usually successful, is to turn the point of the instrument inwards towards the median line through a quarter of a circle, and then to withdraw it until its beak is caught on the nasal septum (Plate II.). The instrument is now again rotated through an angle of 180° , so that its point is brought at right angles to the lateral wall of the

pharynx. In most cases this will bring it either into the orifice of the tube or else directly opposite to it, so that a little pressure of the beak outwards, produced by moving the outer end towards the median line, will cause it to enter. To get the instrument into the exact axis of the tube it will be necessary to turn it still farther, so that the ring points towards the outer angle of the eye.

(2.) Another method of finding the orifice of the tube is to turn the instrument outwards at once through nearly a quarter of a circle. The outer end is then pressed towards the median line, and by this means pressure is made on the lateral wall of the pharynx with the point. The instrument is then gently withdrawn until the beak is felt to glide over the posterior prominent edge of the tubal orifice, upon which it is at once turned a little farther outwards, so as to make the ring point towards the outer canthus.

(3.) A method which finds favour with some, and which is probably more suitable for a silver than a hard rubber catheter, is not to turn the instrument at all when it has reached the posterior wall of the pharynx, but to pull it outwards until the beak hooks against the soft palate; it is then pushed slightly back again and turned outwards as before.

Each of these methods may be adopted in turn where difficulty is experienced, and a little perseverance will generally be rewarded with success. Passing the eustachian catheter is not a painful operation, but sometimes causes great tickling and lachrymation. The patient should be told not to contort his face, and to breathe quietly. When the instrument is in position it is fixed with the index finger and thumb of the left hand, the other fingers being steadied on the nose.

With the right hand the nozzle of the air-bag is inserted into its external extremity and air blown into it. In ascertaining whether the catheter is in proper position we are guided by the sensations of the patient and by auscultation; for if air be forced into the catheter when the point is in a patent Eustachian tube, the patient distinctly feels it enter the middle ear, and the surgeon hears it impinge upon the tympanic membrane with a full clear sound. The auscultatory phenomena may be modified as follows:—

(1.) If the Eustachian tube be narrowed the air is heard to pass through it with difficulty, and to impinge but feebly on the tympanic membrane.

(2.) If fluid be present either in the tube or tympanum, a bubbling or gurgling sound may be heard.

(3.) If the tympanic membrane be perforated the air whistles through the perforation, or if the drumhead be in great part destroyed, blows right into the observer's ear.

In attempting to pass the catheter one not unfrequently meets with patients whose inferior nasal passages are narrowed so as to refuse admission to even the smallest catheter. This state of matters may be congenital, traumatic, or caused by the presence of tumours (*e.g.* nasal polypi). Obstructions are not unfrequently met with, especially in the left nostril, but as a rule turning the point of the instrument a little outwards enables it to glide past the obstacle. Occasionally the catheter has to be turned quite round before it can be got through the meatus. If one nostril be obstructed, the orifice of the Eustachian tube on that side may sometimes be entered by an instrument with an unusually large curve introduced through the opposite nostril, or by means of the doubly curved instrument invented by Dr. Noyes.

In the case of young children,¹ of course, catheterism is impracticable, and even some adults make so much fuss about it that it is difficult to carry it out satisfactorily. If only the hand-bag be used to inject air, the catheter is a perfectly safe instrument, provided it be used with care, and without the employment of force. The same can hardly be said of the bougies and tympanic catheters, which it is now the custom of some specialists to employ. They are small instruments which are passed through the Eustachian catheter towards and sometimes into the tympanum. Besides dangers to the tympanic structures, their employment occasionally gives rise to emphysema by lacerating the mucous membrane. Blowing the nose or artificial inflation may then cause air to get underneath the mucous membrane and produce very unpleasant symptoms of choking. If these instruments are employed, it should be only in cases where they can be expected to yield results more satisfactory than other and simpler measures.

In many ear cases it is extremely desirable to study the condition of the nasal passages, the posterior nares, and the pharyngeal orifices of the Eustachian tubes as well as the fauces. The nasal passages are best examined by means of a bivalve speculum and reflected light. Care should be taken not to mistake the anterior edge of the inferior turbinated bone (especially if the mucous membrane covering it be red and swollen) for a polypus. The posterior nares may be examined by the sense of touch, by passing the finger behind the soft palate, or by the sense of sight, by means of rhinoscopy.

Posterior rhinoscopy is the method usually em-

¹ This difficulty may, in cases in which other treatment is unavailing, and the use of the catheter is indicated, be overcome by means of an anæsthetic.

ployed. It is not in the least painful, but often several sittings are necessary to accustom the patient to the presence of the mirror sufficiently to obtain a view of the parts. The apparatus used is the same as in examination of the vocal chords—a reflecting mirror attached to the forehead, a small-sized hand mirror which should form a smaller angle with the stem than that usually employed for the larynx, and in addition a tongue depressor. The patient should be seated in front of the operator by the side of a strong light,¹ and told to breathe quietly through the nostrils. The tongue depressor is put well back so as to keep the tongue down, and the patient directed to hold it. Light is then thrown into the pharynx, and the throat mirror, which must be of very small size, is warmed and gently insinuated, with its reflecting surface turned upwards and forwards along the tongue till it almost touches the posterior wall of the pharynx—almost but not quite, otherwise an inclination to retch on the part of the patient will abruptly terminate the proceedings. The mirror is now behind the uvula, and must be so held that the latter does not interfere with the operator's line of vision, and by moving it slightly a view may then be obtained consecutively of the nasal septum, turbinated bones, and trumpet-shaped openings of the Eustachian tubes. Posterior rhinoscopy is a difficult proceeding in all patients, impossible in some, but satisfactory when accomplished.

¹ Reflected sunlight gives the most satisfactory results when obtainable.

CHAPTER III.

DISEASES OF THE EXTERNAL EAR.

IN this work diseases of the auricle will be dismissed in a few words, not because they are unimportant, but because, being accessible to the eye and hand without the use of special appliances, they only require to be treated upon general medical and surgical principles.

Like other parts, the auricle may be attacked by various skin diseases. Of these the most common is eczema, which may occur in an acute or a chronic form. Erythema, lupus, frost-bite, and erysipelas may be met with here as in other regions. Sometimes herpes attacks the external ear, either in the region of distribution of the great auricular or of the fifth nerve. When this is the case, the characteristic vesicles make their appearance after several days of severe neuralgic pain.

Perichondritis is sometimes met with; and it may be well to remember the occasional existence of a prolongation of cartilage into the lobule, in which case the usually harmless operation of preparing the ears for the reception of rings may produce serious injury. Of tumours the fibrous cystic and vascular varieties are most frequently met with. The former seem to be most common in the lobule, and to occur, according to Roosa,¹ chiefly in consequence of wearing heavy earrings. Epithelioma affecting the auricle has been observed, and is to be diagnosed on general principles.

We can hardly dismiss diseases of the auricle without reference to a curious form of blood cyst called *Hæma-*

¹ *Diseases of the Ear*, by St. J. Roosa.

toma auris, or *Othæmatoma*. Pathologically it consists of an effusion of blood between the cartilage and perichondrium, situated on the anterior surface of the auricle, and covered by slightly reddened or normal integument. The development of the somewhat rounded fluctuating tumour occurs altogether without pain, or is at most preceded by some little feeling of warmth or tingling. From the common occurrence of this lesion among the inmates of asylums it is sometimes called 'insane ear.' Etiologically the disease is probably to be explained as a trophoneurosis leading to degeneration and softening of cartilage. An attempt at repair then takes place with the formation of extremely delicate but vascular granulations, rupture of which is followed by extravasation,¹ resulting in the formation of the characteristic tumour. Authorities differ much as to the best means of treatment. Some recommend the application of ice, lead lotions, and tincture of iodine, while others advocate evacuation of the effused blood by means of a trochar if it be fluid, by free incision if coagulation has occurred.² More recently Meyer³ has recorded good results from methodical massage. As the object of treatment is to prevent deformity, a compress will often prove of use. Pain and tension of course call for incision.

DISEASES OF THE MEATUS.

(1.) *Congenital absence.*

The practitioner may be consulted by parents concerning a child in whom there is unilateral congenital closure of the meatus. This is usually accompanied by a defective development of the corresponding auricle; but in most of these cases the other ear is perfectly

¹ Buck, *Diagnosis and Treatment of Ear Diseases*, p. 41.

² Gruber, *Lehrbuch der Ohrenheilkunde*, p. 286.

³ *Archiv. f. Ohrenheilkunde*, xvi.

normal, and where such is the case an operation would be most injudicious.

Until the patient has arrived at the years of discretion, it is quite impossible to ascertain whether the auditory nerve is fully developed, or in other words, whether the vibrating tuning-fork can be heard on the affected side through the bones of the skull. Then, again, the results¹ of dissection render it extremely doubtful whether in a case of this kind the rudimentary auricle corresponds even approximately in position to the tympanic membrane when the latter exists, for not unfrequently the middle ear and labyrinth are in quite as imperfect a state of development as the external parts. Altogether the difficulties in the way of forming a correct idea of the condition of the deeper structures are so great, that the general consensus of opinion is against operating in these cases, more especially when the other ear is perfect.

(2.) *Impaction of wax (cerumen).*

It is not always easy to determine why in some persons this secretion, which is usually expelled as it is formed, is retained until it accumulates in sufficient quantity to cause deafness and other symptoms. Occasionally this may be traced to attempts at cleansing the ears with the ends of a towel, or instruments sold as aurilaves, both of which act as ramroads, pushing the wax down towards the drum membrane. Again, if a foreign body has remained in the ear for some time, it may act as a nucleus around which wax is deposited. Patients themselves usually refer their deafness to 'catching cold.' The symptoms most complained of vary. As a rule the surgeon is consulted on account of deafness, which is often stated to have come on quite suddenly. This happens when a considerable amount

¹ Gruber, *Lehrbuch der Ohrenheilkunde*, pp. 279, 280.

of wax has accumulated but has not quite closed the lumen of the canal, thus leaving an aperture by which vibrations are conveyed to the drum membrane. If, however, owing to some mechanical cause, such as the entrance of water while washing, jolting in a railway carriage or the like, etc., this becomes filled up, deafness results. Sometimes, on the other hand, the impairment of hearing comes on more gradually.

Deafness is often associated with severe tinnitus, usually of a rushing character, and due to the contact of the obstructing mass with the drum membrane. A very small piece of wax, if lying on the latter, may cause the most disagreeable 'sounding in the ear' without producing deafness. Giddiness, too, is apt to be caused if a piece of wax, whether large or small, exerts much pressure on the membrana tympani. Pain is not a common symptom, although it sometimes occurs, especially when the mass swells up after the addition of fluid, whether introduced for purposes of softening or accidentally.

A peculiar form of laminated epithelial¹ plug is sometimes met with in the meatus, produced by desquamation from its walls. Where this desquamation occurs, the more usual result is a mixture of wax and epithelium, and after removal of the mass the walls of the canal are red and scaly. It is in these cases that I have most frequently heard pain complained of.

In a case of impaired hearing, in which the ear is filled with wax, if the deafness has come on quite suddenly, and if the tuning-fork be heard best in the obstructed ear, we may conclude that after the plug has been removed the hearing will improve. If, on the other hand, the impairment of hearing has been gradual

¹ Described by Wreden as *Keratosis obturans*, *Archiv. of Ophth. and Otology*, 1874, p. 261.

in its onset, then no definite prognosis should be given. The diagnosis of hardened wax is easily made by examination with the speculum, when a dark blackberry-like mass, sometimes having a more or less polished appearance, is seen.

In most cases it will be advisable to soften the mass by frequent instillations of a warm solution of bicarbonate of soda (gr. v. ad ʒi). The patient should at the same time be warned that this proceeding may temporarily increase his discomfort, owing to swelling of the ceruminous plug before it dissolves. After ten or twelve instillations the wax may be readily washed out by means of the syringe. Instruments are rarely required, and if they be used this should always be done under good illumination, the mirror being attached to a forehead band. Should anything more than syringing be required, small bent forceps (Appendix, Plate III. E, a) or a blunt hook (*ibid.* C) may be advantageously employed, provided always the operator sees exactly what he is doing and causes no pain. In syringing, warm water should always be used, while the auricle is pulled upwards and backwards, in order to straighten out the meatus, and the fluid is injected parallel to and along the upper wall. During the process the ear should be frequently inspected, in order that injection against the unprotected membrane may be avoided, otherwise vertigo and faintness are apt to occur. Afterwards a delicate cone of absorbent cotton should be inserted as far as possible, in order to remove any water left in the ear, and then a dry plug of the same material worn for the rest of the day to avoid the effects of cold.

ECZEMA OF THE MEATUS.

As before said, the auricle is a common seat of eczema

which may extend into the external meatus. The latter is, however, often involved primarily. As a rule, the eczema is of the dry desquamative rather than the moist variety, with comparatively little tendency to the formation of crusts, but both forms are met with. This affection of the auditory canal causes itching, and when the products of inflammation accumulate, tinnitus and deafness.

The treatment consists in attention to the general health, the exhibition of arsenic, and local applications; but before using the latter, the ear should be douched with a warm solution of boracic acid (ʒi ad ʒ20), and dried out with absorbent cotton wool. After this, our local treatment must be adapted to the form of the skin affection. If the surface be red and weeping, the oxide of zinc ointment prepared with vaseline, or diachylon ointment, may be employed; if, on the other hand, the disease be chiefly of the desquamative variety, a tarry application—*e.g.* oil of cade (ʒi ad vaselin. ʒi) or a lotion composed of diluted liquor.¹ carbon. deterg.—will be found useful. These remedies may be applied by the patient either with a brush or as drops thrice a day, after previous douching and drying.

If the case be very chronic, good results will often follow the use of a solution of Argent. Nitrat. gr. x. (or more) ad Spirit. Ether. Nitros. ʒi applied by the surgeon with cotton wool wrapped round a probe.

FURUNCLES OF THE MEATUS.

(Syn. Circumscribed inflammation, otitis externa circumscripta.)

The meatus is often attacked by small boils, which are a source of great pain to the sufferer. The

¹ Mr. Field recommends ʒii of Wright's liquor. carb. deterg. to ʒviii of water.

symptoms are usually very marked. There is violent pain, often radiating over the side of the head; which is increased by movement of the auricle and even of the jaws, so that mastication becomes painful. Deafness may result from closure of the meatus, but the disease is one which is more characterized by discomfort than danger to the integrity of the organ. On examining the ear, one or more swellings are seen to encroach upon the lumen of the canal. These are not usually reddened, but are excessively tender. After one furuncle has run its course, another may appear, and at the end of the series the patient is worn out by pain and sleeplessness. There can be no doubt that these boils here, as elsewhere, depend upon a peculiar dyscrasia; but what that condition is, and how it is caused, often remains a mystery. Löwenberg¹ has recently demonstrated the presence of specific micrococci in the pus from boils of the meatus; and it has been suggested that when one is opened or bursts, these organisms enter adjacent follicles and give rise to fresh abscesses.

It has consequently been recommended to apply to the meatus a concentrated alcoholic solution of boracic acid, which is stated sometimes to cause the furuncles to disappear without opening. Probably the most satisfactory treatment is free incision, and subsequent douching with warm boracic lotion. It often happens that patients object to operative interference, and in such cases the insertion of one of Gruber's gelatine bougies² medicated with extract of opium will sometimes act like a charm. The latter are so prepared that they melt at the body temperature, and thus abstract heat from the inflamed tissues, while at the same time the

¹ *Zeitschrift für Ohrenheilkunde*, x. 1881.

² These bougies can be obtained from Vienna through any chemist.

soothing effects of the opium make themselves felt with much relief to the patient. Roosa¹ speaks highly of a plug of cotton wool, saturated in glycerine and inserted into the meatus, as a palliative measure; the *modus operandi* is probably to promote a serous flow from the parts, and thus to relieve tension. Other useful palliatives are instillations of water, as hot as can be borne, or of warm decoction of poppies, and the application of sedatives in the neighbourhood of the ear; but further enumeration is unnecessary, when it is remembered that an incision will in most cases relieve the pain at once.

Although we do not know exactly what state of the system favours the development of boils, yet if a patient be anæmic, the citrate of iron and quinine should be administered; if the bowels be costive, a wineglass of Friedrichshall water should be taken before breakfast. Regular habits and avoidance of late hours should be insisted on. Moreover, Fowler's solution of arsenic, which, I believe with Von Tröltzsch,² has some peculiar effect in preventing the recurrence of aural furuncles, should be exhibited. The sulphide of calcium is a less agreeable but not more effective remedy, which may be administered for the same purpose.

DIFFUSE INFLAMMATION OF THE MEATUS.

(Syn. Otitis externa diffusa.)

This lesion is virtually an acute dermatitis of the skin lining the external meatus. In the osseous canal, owing to the almost inseparable connection between dermis and periosteum, the condition comes to resemble a periostitis in many of its clinical characters.

¹ *Diseases of the Ear.*

² *Lehrbuch der Ohrenheilkunde.*

As to the frequency of this affection opinions differ. From the descriptions given in most of our text-books (Politzer's is a notable exception), one is led to believe that the condition is a common one. From my own experience, I believe that except as the result of injury, irritants, or preceding middle ear disease, diffuse inflammation of the meatus is to be considered as very rare.

When it occurs, there is redness and swelling of the lining membrane, extending to the drumhead, which presents the appearance of inflamed skin. As a result, the outline of the malleus is either indistinct or lost, the meatus presents the appearance of a *cul de sac* of inflamed red tissue, secreting serous or purulent fluid, and the demarcation between tympanic membrane and auditory canal is no longer visible. Finally, perforation of the drumhead may occur.

Pain is of course very marked, and is increased by movements of the jaw and auricle, while the temperature may rise considerably above the normal. The prognosis should be guarded, for the possibility of an implication of the meninges on the one hand (although improbable) and the middle ear on the other render the condition somewhat serious.

The treatment in the early stages (or after injury of the meatus threatening inflammation) should consist in the application of cold compresses over the auricle, two or three leeches in front of the tragus, and anti-phlogistic regimen. If, in spite of this, the pain continues to increase, a stream of hot water, to which a little boracic acid has been added, should be allowed to flow gently into the ear by means of a nasal douche apparatus, the nose piece being replaced by a suitable ear tube, or water as hot as can be borne may simply be poured into the meatus. Great care should be taken

that the stream be not powerful, as otherwise the inflamed drum membrane might be ruptured.¹

If these means still fail to relieve the pain, then the most sensitive part of the meatus should be sought with a probe, and an incision made down to the bone (which, I think, is preferable to multiple scarification); the bleeding may afterwards be encouraged by warm douching. Sometimes a small conical poultice, or cotton wool saturated with glycerine, may be inserted into the meatus; but the use of large poultices is much to be deprecated in the treatment of all aural inflammations, as they favour the formation of polypi² and granulations.

After suppuration has become established, it is necessary to keep the ear clean, and exercise a mild astringent influence upon the secreting surface. This indication is best fulfilled by directing the ear to be douched thrice a day with boracic lotion, and then carefully dried out by means of a wick of absorbent cotton. A small quantity of the dry impalpable powder of boracic acid is then insufflated by means of a quill with a piece of india-rubber tubing attached to one end.

Sometimes one meets with cases of what may be termed *chronic otitis externa*. A small quantity of ill-smelling pus is secreted in the ear, but rarely in sufficient quantity to escape from the meatus. The drum membrane is often more or less reddened, or it may have on its surface small fleshy granulations. It wants great care, however, to diagnose this affection, for in most cases of purulent discharge a per-

¹ Opium bougies are not as effectual in this as in the circumscribed form of inflammation. In both the instillation of anodynes, as recommended in the chapter on acute inflammation of the middle ear, may be employed to palliate violent pain. As a rule, however, the continuous application of heat and moisture recommended above will be equally effective.

² Roosa, *op. cit.* p. 122.

forated drum membrane gives exit to matter which is derived from the mucous lining of the tympanum. Otorrhea, from chronic inflammation of the meatus alone, will usually yield to the use of boracic lotion and powder. Another useful astringent is zinc. sulphat., acid. carbol. āā gr. v. aq. ʒi, twenty drops to be warmed and instilled thrice daily after syringing and drying. If small granulations do not disappear through this treatment, they may be touched with nitrate of silver, or an alcoholic solution of boracic acid may be dropped into the ear thrice a day, the spirit exercising a destructive influence upon these growths. If the discharge should prove very obstinate, the inflamed surface should be painted with a solution of nitrate of silver by means of cotton wool wrapped round a probe (gr. x.-xx. ad ʒi).

FOREIGN BODIES IN THE EAR.

Sometimes it happens to sportsmen and others who are much employed in the open air that an insect crawls or flies into the ear. The intruder, by pressing against the drum membrane and the sensory nerves of the meatus, produces the most alarming symptoms, which may comprise giddiness, faintness, nausea, and a sensation of sound likened by the sufferer to thunder. A syringe of warm water, however, will easily wash out the offender. If a syringe be not at hand, the ear should be filled with some innocuous fluid, which will either kill the unwelcome guest or render his position untenable. In the ears of those who suffer from otorrhea, and do not pay attention to cleaning the part, flies, attracted by the offensive odour, sometimes deposit their eggs. The result is that the latter in time develop into maggots, which attach themselves to the

tissues with little hooklets. On inspecting the ear, small white moving worm-like bodies are seen; these may either be torn out with forceps, or else killed by injection of chloroform vapour or alcohol, and then removed by means of the syringe.

Of inanimate objects, a great variety have been extracted from the ear, *e.g.* peas, beans, pieces of slate-pencil, buttons, etc.

The first thing the surgeon has to do is to assure himself of the presence of the foreign body by the sense of sight. In the next place, a stream of warm water should be injected; and if the case has not previously been tampered with, this will in many instances remove the offending mass. I have in this way extracted a piece of slate-pencil which was firmly impacted across the meatus, and seemed quite immovable when touched with a probe. If ordinary syringing be unsuccessful, we may lay the patient on a table with the head hanging over the edge, and then use the syringe.¹ In this way the current of water is aided by the force of gravity.

An ingenious device has been suggested by Löwenberg, which consists in dipping a paint-brush in glue, and applying it to the foreign body until the cement sets.

If instruments be required in extracting a foreign body, I believe the safest that can be used is a small blunt hook (Plate III., Appendix E), which can be passed flat along the wall of the meatus, and then turned so as to hook upon the substance it is desired to extract. In the case of soft bodies a sharp hook may also be used. I have had made a small pair of ordinary ear forceps with crossed branches, so modified that the

¹ This method was suggested by Voltolini. The same surgeon also on one occasion broke up a foreign body by means of a galvano-caustic point, and was so enabled to extract it. Roosa, *Diseases of the Ear*.

extremities gradually taper off into sharp teeth. When the branches are closed they are fixed by a spring catch. The advantage of this instrument is, that it can lay hold of the foreign body if it be not too hard, without passing its greatest diameter.

As a rule, a foreign body in the meatus does no harm, although in some rare cases peculiar and sometimes anomalous nervous symptoms have been observed, which disappeared after removal of the offending substance.

Such cases are, however, quite exceptional, and it is, as a rule, injudicious attempts at removal which cause injury and danger. If the meatus be much inflamed from improper efforts at extraction, it is well to apply two leeches in front of the tragus, and to await a return of the parts to their normal state before interfering. This rule I would apply even when the foreign body has been forced into the tympanum.¹ The ear should, of course, be frequently syringed, perhaps three or four times a day, and the patient be kept under observation. Purulent discharge will usually result from the combined effects of the presence of the extraneous mass, and attempts at its removal. If exacerbation of pain and threatening head symptoms point to deep-seated tension (owing to the inability of the products of inflammation to escape), we must remove the foreign body at all risks, for the question will be one, not of preservation of hearing power alone, but of life and death. The surgeon must then be guided by circumstances in the choice of instruments. It may even be necessary to loosen the auricle from its attachment posteriorly, so as to be better able to reach the foreign body. If this be a pea, bean, or any other substance which is likely to swell from

¹ The affinity which this substance has for water is well known.

endosmosis, the instillation of glycerine¹ should be tried before resorting to extreme measures. Where the substance is lodged in the tympanum, injections through the Eustachian catheter may also be resorted to.

OTOMYCOSIS.

(Syn. Otitis parasitica. Mysingomycosis aspergillina.)

By otomycosis or otitis parasitica is meant a chronic inflammation of the external meatus caused and kept up by the presence of a vegetable fungus. The latter is usually one of the forms of aspergillus, although other varieties have been met with (*e.g.* *ascophora elegans*, *tricothecium roseum*, *mucor mucedo*, etc.). Schwartze was the first who brought the existence of this disease before the profession, although isolated cases had been previously observed and reported. The cause of the affection is probably to be sought in some chronic unhealthy state of the meatus, or in the presence of dried-up discharge, either of which conditions will afford a suitable nidus for the parasite. The presence of rancid oily matters in the ear, and living in damp, mouldy dwellings, may possibly predispose to the disease, although Burnett² found it frequently in the upper classes and those who lived under the most favourable hygienic conditions. Locality, too, must have a decided influence upon the frequency of the disease. I have within the last five years seen only one case in Edinburgh; while, on the other hand, from some clinics numerous cases are reported.

The symptoms caused by the presence of fungus in the auditory canal are a sensation of fulness, tinnitus, sometimes vertigo, more or less itching, and occasion-

¹ Compare case described by Roosa, *Diseases of the Ear*, p. 170.

² *American Journal of Otology*, April 1879.

ally pain. There may also be a slight serous discharge. On inspecting the meatus it is seen to contain whitish or dark flakes, which often resemble wet newspaper. These may be removed by forceps or the syringe, leaving the parts beneath reddened, but in the course of a few hours after removal they are reproduced. Examination of the material with the microscope reveals abundant mycelium and spores, with here and there a fruit-bearing stalk. In cases of perforated drum membrane, the fungus has been found in the tympanum.

The first rule in treatment is absolute cleanliness, and sometimes this alone is sufficient, the ear being syringed three or four times daily with warm water. It is best, however, to combine with this the instillation of some parasiticide, of which class the most approved remedies are rectified spirit, pure or diluted, and a warm solution of hypochlorate of lime (grs. ii. ad 3i), although many others have been suggested and used.

OBSTRUCTION OR NARROWING OF THE EXTERNAL AUDITORY CANAL.

Sometimes as a result of inflammation the meatus becomes completely closed, either by formation of a membranous septum or of dense bone. The treatment of the first-named condition is simple. A crucial incision, followed by the introduction of a tube or piece of laminaria to prevent reunion of the flaps, will be all that is required. On the other hand, in the case of acquired osseous obstruction, it is undesirable to operate unless we have reason, from the occurrence of deep-seated pain or head symptoms, to believe that pus is being formed behind the obstruction. The vital indication is then to establish an opening by means of a small trephine or drill.

More common than complete obstruction is narrowing of the lumen of the external meatus. Sometimes from congenital causes the anterior and inferior walls of the bony portion encroach so much on the calibre of the tube that inspection of the membrane in its entirety becomes impossible, while in old people the cartilaginous meatus may be reduced to a mere vertical slit. As a result of inflammation, too, there may be a symmetrical narrowing of the tube. In these cases the narrowing in itself is rarely sufficient to cause deafness, but impaired hearing may result from a collection of wax or epithelium behind the stricture. The treatment to be adopted is that which has already been recommended for impacted wax.

Another cause of diminished calibre, upon which we must dwell at some length, is the presence of EXOSTOSES in the meatus. These growths may be small, in which case several are usually present, or the whole canal may be filled by one large growth. The diagnosis is easy, for when touched with a probe they have a quite unmistakable bony feel. The skin which covers them is either pale or very slightly reddened.

The etiology of these tumours is still involved in mystery. Roosa seems to consider them to be usually inflammatory, while other authors have ascribed them to a syphilitic or arthritic diathesis. A curious fact, to which Dr. Urban Pritchard¹ called attention, is the common occurrence of multiple exostoses in the wealthy classes, while they are rarely found in hospital or dispensary practice. It must be borne in mind that an exostosis does not produce deafness or any other symptom directly, unless it fills up the entire canal. Usually at worst a small aperture is left at some part of the circumference by which sound-waves may reach the

¹ *Transactions of the International Congress*, 1881, vol. iii. 369.

drum membrane. This aperture is, however, very liable to get filled up either by epithelium or wax. When this occurs, with resulting deafness, an alkaline solution should be either instilled, or, if necessary, injected through a fine india-rubber tube in order to soften and wash out the obstructing matter. A solution of bicarbonate of soda (gr. v. ad i) well warmed serves the purpose best. If the growth blocks the canal entirely, we should not, I think, undertake an operation unless the other ear is also useless, for the ivory-like hardness of the tumour and the close proximity of vital structures render the removal or perforation of an exostosis in this region a most serious matter. Here, as always, if the obstruction of the meatus prevents the egress of pus, a free opening must be made at all risks. The dental drill seems to be the most useful instrument for the purpose of establishing an opening through an exostosis.

Injections of much diluted nitric acid¹ seem to have been found useful after a portion of the bone has been penetrated — the acid acting apparently as a solvent. In conclusion, I would recommend those about to operate on a case of aural exostosis to read Mr. Field's² very excellent chapter on this subject. Painting the growths with iodine seems to be sometimes useful, but it can at best exercise only a very slight effect.

¹ 'The Use of dilute Mineral Acids in the Treatment of Caries, Necrosis, and Exostoses of the Ear,' by Urban Pritchard, *Brit. Med. Journal*, 1882, vol. ii. 781.

² *Diseases of the Ear*, chapter V.

CHAPTER IV.

ACUTE INFLAMMATION OF THE MIDDLE EAR.

(Syn. Acute catarrh, acute suppuration, etc.)

It is customary in text-books to distinguish under separate headings acute catarrh of the tympanum and acute suppuration. Such a classification is justified perhaps on clinical grounds, but is unnecessary, and not pathologically tenable. It is said that in both forms the lining membrane of the tympanum is in a state of acute inflammation, but that the exuded fluid is in the one case composed of mucus, and in the other of pus. I believe, however, that no surgeon would take upon himself to diagnose the exact form of exudation in a severe case of so-called acute catarrh; and I maintain, moreover, that in these cases, as described in text-books, the secretion is as often purulent as mucous. The Eustachian tube generally shares in the inflammation, and in severe cases the mastoid cells are also involved. Acute inflammation of the middle ear may be produced by any cause which is capable of setting up acute naso-pharyngeal catarrh. Indeed, it is usually secondary to a cold in the head or sore throat. It follows that it is often caused by the exanthemata, more especially by those which, like measles and scarlatina, are liable to attack the degluto-respiratory tract. Occasionally acute otitis media may owe its

origin to sea-bathing, exposure of the ear to cold, or the entrance of fluid through a perforation of the drumhead, or through the Eustachian tubes, *e.g.* during the employment of the nasal douche.¹

Before going further it may be well to inform the reader that this affection—fortunately often in its milder forms—is the acute earache of childhood. Probably for one case of earache from inflammation of the meatus, the practitioner will meet with twenty caused by acute disease of the middle ear. The latter is very apt to occur in young children during the first months of life, as shown by Von Tröltseh,² Kutscharianz, and others.

Of the symptoms produced, pain is the most constant and marked. From the nature of the parts inflamed the suffering is severe, for the mucous lining of the tympanum represents the periosteum as well. The pain, of course, varies with the degree of inflammation. It is generally felt deep in the ear, and radiates over the side of the head. While not usually affected by moving the auricle or chewing, it may be increased by pressure inwards of the tragus, coughing, or swallowing. If the case be mild there may be distinct intermissions, and even in severe attacks occasional remissions occur. In some rare cases the disease runs its course without pain; this is more particularly the case in phthisical patients. Tinnitus aurium is generally complained of, while vertigo is a comparatively rare symptom.

The temperature usually rises, and an examination of the throat often gives evidence of acute inflammation, which is either still active or undergoing resolution. Deafness is marked, and continues to increase from day to day as the lining membrane of the drum swells, and the products of inflammation are poured out. Some-

¹ Pointed out by Roosa.

² *Lehrbuch der Ohrenheilkunde*, 404.

times the power of hearing the vibrating tuning-fork, through the bones of the head, is temporarily lost. This may be due either to congestion of the labyrinth, or pressure of exudation upon the fenestræ.

In a form described by some authors as acute myringitis (inflammation of the tympanic membrane), all the objective signs about to be described may be met with; but from the small degree of deafness present the inflammation is assumed to have confined itself to the drum membrane, leaving the ossicles unfettered in their motion.

The appearances of the membrane are characteristic in acute tympanic inflammation. In a mild case it is less polished and more decidedly grey than normal, and often more or less concave from accompanying Eustachian obstruction. Behind the handle of the malleus dilated vessels make their appearance, and these may be followed towards the periphery, where a more or less diffuse redness is often found. Then again, in a severe case the outline of the malleus is lost, or only the short process is seen, while the remainder of the membrane presents all the appearances of inflamed skin (Pl. V. A). Little vesicles or abscesses even may form on its surface. As the disease progresses the epidermis is loosened in white flakes by serous exudation (Pl. V. B), and often presents dark purple clefts. At a later stage the drumhead becomes distinctly bulged, generally at its lower part, and sometimes the intra-tympanic exudation can be distinguished by the modification of colour which its presence produces in the membrane, if the latter have not lost all its transparency.

In rare cases the inflammatory action seems to limit itself to circumscribed parts of the drumhead, but in a small work it is impossible to describe in detail

every possible change of appearance. The osseous meatus near the membrane usually participates more or less in the redness and inflammation.

After a few days of suffering, which varies in degree according to the severity of the attack, resolution may begin, or pus or mucus breaks through the membrane, and is discharged from the meatus. In either case deafness will persist for a longer or shorter time. If a flow of pus has become established, the condition may become chronic, and it is in this way that chronic middle ear suppuration almost invariably arises.

In very young children the symptoms of acute otitis media are those of severe suffering, as evidenced by crying. The hand of the infant is put up to the ear constantly, and it refuses to lie on the affected side. Pressure on the tragus causes the patient to shrink and cry.

Roosa¹ has described a peculiar form of the disease under consideration, which he designates otitis hæmorrhagica, and I have also met with a similar case. Violent pain is complained of; in a very short time a feeling of something giving way is experienced, and blood flows from the ear through a perforated drum membrane.

The prognosis varies according to the intensity of the inflammation, as indicated by the symptoms and objective examination. If, as is often the case with children, the pain is only felt at night, and the drum membrane is but slightly injected, we may, under suitable treatment, look for a speedy cure. If, on the other hand, the pain be very intense, with but slight remission, and the drumhead presents the objective appearances of severe inflammation, the prognosis should be guarded. Pus is then often evacuated

¹ *Diseases of the Ear*, p. 254.

through a perforation; and although in most cases—except those in which the ear disease is secondary to one of the exanthemata—a complete cure results under appropriate treatment, yet the hearing is sometimes permanently impaired. During the course of the disease the mastoid process may become swollen and tender, a serious and unpleasant symptom, showing that the inflammatory action has attacked the cells.

Acute inflammation of the tympanum is sometimes, although rarely, the exciting cause of meningitis or cerebral disease. It is when the affection has become chronic that this result is most to be dreaded.

The treatment may be conveniently considered under three headings—(1) general treatment; (2) treatment of the inflamed part; (3) treatment of subsequent deafness.

(1.) The patient should be confined to his room, or, in a severe case, to bed, and a saline purge may be administered with advantage. As acute middle ear inflammation is usually associated with naso-pharyngeal catarrh, a warm soothing gargle and diaphoretics will generally prove useful. The diet must be non-stimulating, and in the acute stage alcohol and tobacco should be prohibited.

(2.) Some authorities use cold compresses, frequently changed, applied over the auricle if the case be seen early, in order, if possible, to abort the attack. According to Weber Liel,¹ this treatment should not be pursued in cachectic, rheumatic, or syphilitic individuals, but in other cases is extremely useful. A more generally accepted plan of treatment is the application of leeches over the mastoid process and in front of the tragus, one or two in each situation. In every case

¹ *Separat-Abdruck aus der Real-Encyclopädie der gesammten Heilkunde* (Eulenburg), p. 46.

in which either pain or redness of the membrane is marked, I would recommend this as the first step in treatment.

A very simple and effectual anodyne is the irrigation of the ear by a gentle but continuous stream of water as hot as can be borne, or it may be poured into the ear frequently with a teaspoon. The water may be medicated with morphia, or a decoction of poppies may be substituted. The instillation of a few drops of solution of atropine (gr. ii. ad ʒi) is said to be very efficient. While large poultices are to be avoided, hot stupes sprinkled with laudanum may be applied, and a warm hop pillow may also prove grateful to the sufferer. Politzer¹ speaks highly of the application of a large piece of cotton wool upon which have been sprinkled twenty or thirty drops of a mixture of olive oil and chloroform. He also recommends that the whole head be enveloped in cloths wrung out of hot water. Anodyne liniments, *e.g.* aconite, may also be applied in the neighbourhood of the ear. If, in spite of these means, the pain continues unabated, or if, from the intense bulging of the membrane, perforation is threatened, tension should be relieved by incision. Usually the most prominent part is the posterior inferior quadrant, and in this situation a small opening should be made. As in these cases a mere prick is often sufficient, Woakes' guarded knife will be found very convenient for the purpose. Probably in the acute otitis media of measles and scarlatina, early incision is useful, as tending to prevent the often great loss of tissue in the drum membrane, which results after spontaneous perforation, if the operation be not contra-indicated by the patient's general condition. In other cases, however,

¹ *Lehrbuch der Ohrenheilkunde.*

I am disinclined to incise unless compelled to do so by the severity of the pain and tension,—when I class the operation as a palliative one,—or by the threatened spontaneous rupture of the membrane as indicated by great bulging. Tenderness and swelling over the mastoid, which does not yield to leeching, calls for a free incision down to the bone. The cut should be about half an inch behind the attachment of the auricle, and parallel with it. If pain returns after artificial or natural perforation of the membrane has occurred, Politzer¹ finds great relief result from the injection of hot water through the Eustachian catheter.²

(3.) After the inflammation has run its course, considerable deafness usually remains. This is due partly to the presence of free exudation in the tympanum, and partly to the swollen condition of its mucous lining. If pus has been discharged or evacuated through the membrane, we have, in the presence of the perforation, an additional factor of deafness. In most cases, too, for a time the lumen of the Eustachian tube is constricted.

If a discharge of pus through the drumhead exists, we should, by means of injections of air from within, force it into the meatus. It is then to be syringed out thrice a day with warm boracic lotion (1-80), after which the ear is carefully dried with absorbent cotton wool, and a small quantity of boracic acid in impalpable powder is blown into the meatus. If this fails, a solution of sulphate of zinc (zinc sulph., acid. carbolic. āā gr. v. aq. ʒi) or acetate of lead may be used in preference to the stronger caustics sometimes recommended. The use of Valsalva's method,

¹ *Loc. cit.*

² By means of the small syringe, figured in Appendix, Plate II. H. After the fluid is injected into the catheter it is forced onwards by means of the air-bag.

or, better, Politzer's bag, must be insisted on in these cases, not only in order to drive out retained secretion from the tympanum, but also to prevent the formation of adhesions between the membrane and the inner wall of the drum cavity.

If the surgeon has succeeded in preventing perforation, he should begin to use Politzer's bag a day or so after all pain has ceased, and continue it daily for ten days or a fortnight. After this he must be guided by circumstances; as a rule, so long as its use is followed by distinct improvement in hearing, and the drum membrane shows no signs of undue relaxation, only good can result. If there be reason to suspect the presence of much free exudation, it is well to practise inflation while the head is bent forwards and to the opposite side. By this means the anterior wall of the tympanum is temporarily converted into the floor, while the opening of the Eustachian tube causes a free drain into the pharynx (Poltzer). In most cases it is preferable to use one of the modifications of Politzer's method as suggested by Gruber or Holt, as by these means the current of air is driven into the tympanum with less force. When, however, the Eustachian tubes are much obstructed, it may even be necessary to employ the catheter. Auscultation during the process will often detect moist râles due to the presence of free fluid in the tympanum or Eustachian tubes.

CHAPTER V.

CHRONIC SUPPURATION OF THE MIDDLE EAR.

(Syn. Otitis media suppurativa chronica. Otorrhea.)

THIS affection is invariably a result of the preceding acute form, and to consider the etiology of it further would entail a needless amount of repetition. It is true that in phthisical patients pus sometimes accumulates in the tympanum, and is evacuated through the drum membrane without pain, but yet I think that this must be looked upon as an acute condition tending rapidly to become chronic. Undoubtedly, acute middle ear inflammation occurring during scarlatina and measles is much more apt to become chronic than the same affection resulting from nasopharyngeal catarrh, hence a large proportion of cases met with can be traced to one of these exanthems. As a rule, it may be said that in all cases in which there is a considerable amount of discharge from the ear, this is due to an inflamed and suppurating condition of the tympanic mucous membrane, and is poured through a perforated drumhead. It follows then that the copious otorrhea so frequently met with is virtually equivalent to chronic suppuration of the middle ear. This affection, so common in early childhood, is often set down to struma. It is more than likely that scrofula plays an important part in preventing the action of the

vis medicatrix naturæ, but it must also be remembered that an ulcerated discharging surface may be enough to account for the presence of enlarged glands, which may then caseate, and lay the seeds of tubercular disease.¹ Chronic middle ear suppuration is peculiarly apt to give rise to complications, which we shall consider in a subsequent chapter (*e.g.* granulations and polypi, mastoid disease, caries, pyæmia, cerebral abscess).

The patient is often brought to the surgeon on account of a 'running ear,' or perhaps, more frequently, on account of a bad-smelling discharge which annoys those who are brought in contact with the sufferer. Often these cases have been long neglected, and if asked for an explanation, the statement is generally made by parents or patient that it was considered dangerous to interfere, or even that the otorrhea was believed to be salutary by the family physician. *A propos* of this subject, Roosa naively remarks that the Creator would have made us with discharging ears if they were necessary for our well-being. Any one who notes the histories of a number of cases of neglected ear disease—suppurative or otherwise—will find strange revelations as to medical ethics. The observer will meet with patients incurably deaf, or perhaps the victims of caries of the temporal bone, threatening life itself, as a result of disease curable in its early stages. Such patients will often tell how the doctor was consulted, and how in one case they were told that the discharge was beneficial, or in another that the deafness would disappear at puberty. From no line of argument founded upon rational data of pathology could such conclusions be arrived at, and I hesitate to apply the proper epithet to such empirical statements and pro-

¹ Compare Von Tröltsch, *Lehrbuch der Ohrenheilkunde*, 459.

phacies coming from medical men in whom patients place confidence.

Sometimes, instead of the discharge being the symptom for which relief is sought, the surgeon is consulted on account of deafness. If asked whether any discharge is present, the reply is given that the ear occasionally runs when the patient catches cold. Sometimes it is true that in cases of this disease the mucous membrane only discharges pus at intervals, but as a rule the flow is more or less constant, though not always in sufficient quantity to run out of the meatus, in which case the latter will be found to contain masses or crusts of ill-smelling pus.

Noises in the head are rarely complained of, while giddiness is not uncommon. I have¹ even seen epileptic attacks, which seemed to be due to chronic suppuration² of the middle ear. Urbantschitsch has pointed out that in quite a number of cases taste is defective, on the corresponding side of the tongue, owing to involvement of the chorda tympani in its passage through the ear. The amount of deafness varies very much, being sometimes marked, while again it can often be appreciated only by careful testing.

The objective signs met with on examining the deeper parts of the ear present almost as many variations as the number of cases examined. Sometimes the discharge is scanty, and on examining the ear the drum membrane is seen to be more or less thickened, partially cicatrised or chalky, and a perforation with clean cut margins is often distinctly visible. Through this the mucous membrane lining the drum cavity may be open to view (Plate VI. A). According to

¹ 'Epilepsy, Vertigo, and Ear Disease,' by P. M'Bride and A. James, *Edin. Med. Jour.* 1880.

² *Lehrbuch der Ohrenheilkunde*, 413.

the amount of inflammation present, it will be seen to be red and granular, or of a pale pink, more nearly approaching the yellow grey of health. The size of the perforation varies from that of a pin's head to destruction of nearly the whole membrane. Not unfrequently the handle of the malleus is seen, as it were, dissected out, and lying on the promontory, supported only by a narrow rim of membrane above.

In most cases it is only after the ear has been syringed and dried out that anything like a careful examination can be made. We can, however, often suspect the presence of a perforation, even when the ear is full of pus, as the latter will be seen to rise and fall synchronously with the heart-beat. Occasionally, if the perforation be very small, or situated in the most anterior part of the membrane, the eye cannot detect it; but inspection, while air is forced through the Eustachian tubes, will reveal a mixture of fluid and air bubbling through. Suction with Siegle's speculum will also produce a like result. In difficult and doubtful cases, too, the auscultating tube will have to be called to aid while air is blown through the Eustachian catheter.

Sometimes the drum membrane, or so much of it as remains, becomes swollen and œdematous. If the perforation is very small, the diagnosis becomes difficult, as this condition may readily be mistaken for polypus.

The prognosis, in all cases in which the acute disease has merged into a distinctly chronic type, must be guarded in the extreme—even in uncomplicated forms, such as we are now considering. It can never be foretold how the suppurative process will end until the perforation actually heals; and even if this result

be arrived at, the hearing often remains permanently impaired.

Cases of otorrhea in which the perforation is very small, or in which the latter is situated in the membrana flaccida, are more serious than others. In the former there is more risk of tension with all its dreaded sequelæ, while the latter is known to be frequently associated with caries.¹

In these cases of chronic suppuration the discharge sometimes defies treatment. Then, again, the otorrhea may cease, and the parts return to a state of comparative health, with the exception that the drum membrane remains thickened or otherwise altered and perforated (dry perforation). Perhaps, on the whole, the most desirable issue is cicatrisation, although it must be admitted that the hearing at times becomes worse after healing. The cicatrix is either very thin and transparent, and only recognisable by the effect of the air douche or suction applied by the pneumatic speculum, which causes it to bulge towards the meatus (Plate VI. B and C), or it presents the appearance of a dark brownish spot. In either case it is to be distinguished from atrophy of the membrane, which presents similar characteristics by its well-defined border. In some neglected cases the cicatrix and edges of the perforation become adherent to the inner wall of the tympanum and other parts, producing many and variously distorted appearances. The membrane, or so much of it as is left, often becomes infiltrated with calcareous matter in patches (Plate VI. D), which from their peculiar whiteness are readily recognised by means of the speculum as chalky deposits.

In the treatment of chronic suppuration it is of great importance to attend to the general health. Cod liver

¹ Hessler, 'Beitrag zur Pathologie und Therapie der Perforationen der Schrapnell'scher Membran,' *Archiv. f. Ohrenheilkunde*, Bd. xx.

oil, iron, iodide of iron, and other drugs must often accompany local medication to make it successful. If the case be in the transition stage, from acute to chronic, a change of air will often work marvels. In local treatment we must remember that cleanliness is essential, and we must, moreover, consider the pathological factors of deafness, viz. :—

(1) The clogging of the parts concerned in the act of hearing by viscid or hardened secretion.

(2) The swollen and suppurating condition of the mucous membrane, which impedes vibration.

(3) The presence of a perforation. This alone impairs the hearing, but only to a limited extent, for many persons in whom it exists can hear fairly well.

(4) Various changes produced by the process of healing.

These data afford the surgeon important indications for treatment.

The instillation of a warm solution of bicarbonate of soda will dissolve away hard secretion, and an injection of air through the Eustachian tubes will drive it into the meatus; when there it can be removed by means of the syringe and a warm solution of boracic acid (ʒi to a pint). The ear must then be dried and a remedial agent applied, thus meeting the second indication. For most cases no treatment is so suitable as the insufflation of a small quantity of boracic acid in impalpable powder, the auricle being pulled well back and a tube containing the acid inserted into the meatus. A very convenient instrument can easily be improvised with a goose quill and piece of india-rubber tubing. This treatment, so successful in many cases, can be carried out perfectly well by intelligent patients at home, and should be repeated thrice daily, only an occasional visit to the surgeon being required.

If the Eustachian tubes be not obstructed, Valsalva's experiment is quite sufficient to drive the fluid from the tympanum, although Politzer's method of inflation should be used at intervals.

In some cases, especially those in which a large perforation exists, through which the mucosa of the tympanum is seen to be in a swollen and granular condition, the instillation of from ten to twenty drops of rectified spirit may with advantage be substituted for the boracic acid powder. Sometimes it is found advantageous to alternate the two remedies.

The instillation of very strong solutions of nitrate of silver (1 in 20 to 1 in 10) has been much advocated both in Germany and America. In my own practice I only use nitrate of silver in obstinate cases where there is a large perforation, and then apply the solution by means of cotton wool twisted round a probe.¹

If these means of treatment fail, we may fall back upon the instillation of warm astringent solutions, *e.g.* zinc. sulphat., acid. carbol. āā gr. v. ad ʒi. Ear drops containing acetate of lead, borax, and other astringents are also much used. The insufflation of powdered alum is often recommended, but it is open to the serious objection that it may by its mechanical effect (formation of hard masses) cause obstruction to the egress of the secretion. The so-called dry treatment recommended by some aurists is not likely to come into general use.

It may happen that the hardened pus forms lumps which cannot be removed by the syringe as generally used. It is then desirable to insert a delicate india-rubber tube into the meatus until it is in contact with the offending mass, and so break it up by a current of fluid. Some practitioners, by means of small specially con-

¹ In this, as in all similar manipulations, the forehead mirror must of course be used.

structed instruments, made to pass through the perforated membrane, syringe directly into the middle ear, with the hope of removing hardened secretions from the tympanum. I much prefer, however, to trust to the solvent action of a solution of soda in the case of a fairly large perforation. When, on the other hand, the opening is small, I would hesitate to introduce an instrument.

Politzer has often found marked benefit from forcing a weak solution of boracic acid through the Eustachian catheter, thus washing out the tympanum from within. Hinton¹ used the opposite method, which consisted in injecting a solution of soda from the meatus through the Eustachian tubes into the pharynx. It is of great importance to inflate the middle ear at regular intervals, both in order to drive out the secretion, as before said, and also to prevent the formation of adhesions during the process of healing.

ARTIFICIAL MEMBRANE.

In cases in which the drum membrane is perforated, and in which, at the same time, the deafness is very marked, the hearing power may occasionally be much improved by the use of an artificial membrane. The term is perhaps somewhat misleading, as it is now generally believed that the therapeutic action is due not to closure of the perforation, but to the support afforded to the auditory ossicles, more especially the stapes, by constant and gentle pressure. Knapp² believes that the action of the artificial membrane varies in different cases. Thus if the chain of ossicles be dragged inwards, and as a result the stapes be

¹ *Questions of Aural Surgery.*

² *Transactions of the International Congress, 1881, vol. iii. p. 380.*

too much pressed into the fenestra ovalis, pressure upon the upper part of the malleus, which is situated above the axis of rotation, will cause outward movement of its lower part, and relieve tension; while if the converse be the case, pressure on the inferior extremity will produce increased inward pressure of the stapes. However, be the action what it may, the fact remains that in certain cases of perforated membrane, gentle pressure produces considerable improvement in hearing. The instrument most commonly used is the 'artificial tympanum' of Toynbee, which consists of an india-rubber disc attached to a wire handle. The auricle being pulled backwards, it is introduced until it is in contact with the membrane. Another useful appliance—I should perhaps say the most useful—is a moistened pellet of cotton wool applied to the perforated drumhead by means of forceps. If otorrhea be still present, it may be soaked in a solution of boracic acid, sulphate of zinc, or other astringent, in glycerine and water. Gruber uses discs of india-rubber or linen attached to a silk thread, thus avoiding the use of a wire, which is so objectionable in Toynbee's instrument, while Blake has suggested the employment of discs of sized paper.

In any given case it is quite impossible for the surgeon to find out whether the artificial membrane (or pellet of moist wool) is likely to prove beneficial without first trying the effect. If the result be satisfactory, as evidenced by improvement in hearing, the patient should be instructed in the method of introduction, and if the cotton pellet be used, supplied with a pair of forceps for the purpose. Mr. Field has suggested a combination of Toynbee's instrument, with cotton wool or sponge, which seems to combine ease of introduction with the advantages of the plain cotton pellet.

Whatever form of artificial drumhead be used, it should not be worn for any length of time uninterruptedly, until the ear has become accustomed to what at first must act as a foreign body. Half an hour a day to begin with, gradually increased, is sufficient, while it should always be removed if it causes any discomfort, and on going to bed.

Michael¹ has suggested the use of what he terms a fluid artificial drum. He instils glycerine (medicated in some cases with tannin) and then collodion, which first floats on the glycerine and then forms a membranous covering retaining it in position. I can distinctly recall a case of destruction of a large portion of the membrane, in which the patient's hearing power could be improved by means of a drop of glycerine, but by no other method. No doubt, had the glycerine been fixed by the means described, a more or less lasting improvement might have been attained.

Berthold has suggested the transplantation of a piece of skin over a perforation, the edges of which must, however, be previously irritated by the application of sticking plaster. In this way he succeeded in replacing the lost tissue, but without benefiting the hearing power. Other attempts have not been—so far as I know—more successful.

¹ *Transactions of the International Congress*, vol. iii. 434.

CHAPTER VI.

COMPLICATIONS OF CHRONIC SUPPURATION OF THE MIDDLE EAR.

Granulations and Polypi.

ALTHOUGH in exceptional cases granulations and polypi may exist independently of chronic middle ear suppuration, yet such instances are extremely rare.

Granulations are small in size, of a bright red colour, bleed readily, and may spring from the tympanic membrane or meatus, although their most common seat is the mucous membrane of the tympanum. In cases where they exist there is usually a history of bleeding from the ear, in addition to chronic purulent discharge. Often these little tumours are so numerous as to mask all other parts, and when touched with a probe, or even when the ear is syringed, bleeding takes place. Carious processes in the middle ear are usually accompanied by exuberant granulations, to which we shall again refer. In some cases granulations, especially if not very numerous, disappear under the line of treatment which has already been described as appropriate for simple cases of chronic suppuration; but other means may, however, be required, as it is known that their presence frequently keeps up a discharge of pus. Perhaps the most satisfactory, and, at the same time, the simplest method of treatment, is the instillation of rectified spirit,¹ as alcohol seems to have a

¹ This may be diluted at first with warm water in the case of sensitive patients.

peculiarly destructive influence on granulation tissue. Such instillations must be made several times daily, and be preceded by careful syringing and drying. If other means are required, Politzer recommends the use of perchloride of iron either crystallised or in strong solution. The latter is best applied by means of cotton wool twisted round a delicate probe. Occasionally it may be necessary to scrape off the granulations by means of a small sharp spoon.

The term polypus is applied to large growths, which usually arise from the upper or inner wall of the tympanum, but sometimes have their origin in the membrane, and are said to spring occasionally from the meatus. Several growths may be present in the same ear. It is usual to speak of various pathological varieties, *e.g.* mucous polypi, fibromata, and myxomata; but an examination of a considerable number of histological specimens has convinced me that the basis of most polypi is a delicate stroma, holding in its meshes numerous small round cells. Sometimes many of these become elongated into spindles, and eventually into fibres, while less frequently the stroma degenerates into branching myxomatous cells; in the one case a fibroma, and in the other a myxoma is produced.

As I have said, polypi most commonly grow from the mucous lining of the tympanum, and then reach the meatus by passing through a perforated drum membrane. Sometimes they spring from the tympanic membrane, and a case has been recorded in which the malleus was found imbedded in a polypus after extraction. It is commonly said that polypi often grow from the meatus, but I cannot recall an instance. Certainly I have seen three or four cases of what at first sight seemed to be polypus of the

meatus, but in every one a careful examination with a probe proved the growths to be granulation tissue growing round a fistulous opening, either passing towards the mastoid cells or into an abscess cavity. It is, besides, quite unlikely that a mucous polypus can grow from a surface covered by skin. I am inclined to think no analogy could be produced from medical literature, and therefore hesitate to believe in the existence of polypus of the meatus without ocular demonstration. In this difficulty the microscope does not aid us, as histologically it is almost, if not quite, impossible to distinguish granulation tissue from a mucous polypus.

Polypi of the ear vary in size, being commonly about as large as a pea, but often filling up the entire meatus, and even protruding from it, when the covering of the outer portion of the growth tends to assume the appearance and consistence of epidermis. The diagnosis is in most cases easy. An examination of the meatus reveals the presence of a tumour covered by mucous membrane (Plate VI. E), and generally freely movable when manipulated with a probe. The latter, too, can be passed round the growth, an obstruction being usually only met with above, in which situation the pedicle is most frequently situated. As a general rule, the outer surface of the growth is much nearer the eye than the normal tympanic membrane, and this, combined with the mobility demonstrated by means of the probe, prevents any mistake.

There is, however, one condition which is not unlikely to give rise to error. I allude to cases of chronic suppuration of the middle ear, in which only a small invisible perforation is present, while the membrane itself is swollen and œdematous, and the outline of the malleus is entirely lost. It may happen

that the difficulties in the way of arriving at a correct diagnosis are very great; for the most convex part of the infiltrated membrane bulges outwards, and the probe can be inserted past its most prominent part, but is always soon arrested in its course at every point of the circumference. Pressure on the tumour, too, reveals the absence of mobility, and may be followed by marked vertigo.

A characteristic of aural polypi is their tendency to recurrence, so that the treatment must be prolonged after removal. If there be any hearing power left in the ear, and if the tumour be large, a certain amount of improvement may be expected after its removal, but should never be promised. This fact should, however, not deter the surgeon from operating, for at any moment the escape of pus may be hindered by the presence of the growth, and head symptoms set in.

The most convenient instrument for extracting aural polypi is that known as Wilde's snare,¹ which has been modified by various authorities. A loop of wire is guided over the tumour, and drawn tight when as much of the latter has been encircled as possible. Sometimes more than one sitting is necessary, especially if there be several growths; and again, at the first attempt, only a portion of a tumour may come away. Having made out approximately the position of the pedicle, which is generally above, it is a good plan to pass the wire over the polypus, pushing it on until a resistance is encountered, which indicates that the pedicle has been reached. It may happen that from the depth of the growth it is extremely difficult to snare it; and forceps² may then be used to crush it and destroy its vitality, or it may be scraped away

¹ See Appendix, Plate III. D, b.

² See Appendix, Plate III. F.

carefully with a sharp spoon.¹ The circular or ring knife suggested by Politzer does not seem to me to be any improvement upon the snare, nor have I resorted to the galvano-caustic treatment.

After removal of the tumour, there remain a perforated membrane and chronic suppuration of the tympanic cavity, while the stump of the polypus is ready to sprout again. The ear should therefore be kept scrupulously clean by syringing thrice a day; and after it has been carefully dried, fifteen or twenty drops of rectified spirit should be instilled and allowed to remain in the meatus for a time. If, in spite of this, recurrence threaten, the pedicle, or so much of it as is left, should be touched either with nitrate of silver, chloro-acetic acid, chromic acid, or, better still, a strong solution of perchloride of iron, as recommended by Politzer.

There can be no doubt that alcohol has a very decided effect upon mucous polypi. This fact, so far as I know, was first pointed out by Dr. Miller of Edinburgh (who used an alcohol spray for nasal polypi). Afterwards it was used with success for those of the ear by Politzer and myself² independently, the results of the former, however, being published first.

Small growths may entirely disappear without operative means under this treatment, while I have seen a very large polypus diminish by about two-thirds. The mode of action of this therapeutic agent is probably by (1) abstracting water; and (2) coagulating albumen.

It is well known that a very large proportion of the bulk of a mucous growth is composed of water, which alcohol has the power of removing. Again,

¹ This is best done by means of a probe round the extremity of which a little cotton wool has been twisted.

² *Edin. Med. Journ.* 1881.

under its use the soft gelatinous mass becomes much harder, and in this way very considerable pressure is exercised upon the thin-walled vessels which nourish the tumour.

MASTOID DISEASE.

During the course of chronic suppuration of the middle ear, the mastoid process not unfrequently participates in the inflammatory action. For convenience of description we may divide diseases of the mastoid into two classes,¹ viz. :—

(1) Those cases in which there is inflammation of the periosteum covering the outer surface of the process.

(2) Cases in which a deep-seated lesion is present without external signs.

Periostitis of the mastoid may occur during an acute attack of middle ear inflammation, but it is more frequently met with in the course of chronic suppuration, the exciting cause being sometimes exposure to cold, but more commonly retention of pus in the mastoid cells. The symptoms of mastoid periostitis are, violent pain, great tenderness, redness, and swelling behind the ear. As a result, the auricle of the affected side is made to stand out from the head. As the disease advances, pus may be effused between bone and periosteum, and a large abscess result. After opening or spontaneous rupture the use of a probe usually reveals the presence of bare bone, and sometimes a fistulous communication with the pneumatic cells is found, in which case the external opening is likely to persist for a long time.

In the second class of cases the exciting causes are very similar, but the only symptoms present are severe deep-seated pain and tenderness behind the ear, but no swelling or marked redness. We must then assume

¹ Very often both forms coexist in the same case.

the existence of an endostitis, usually set up by the presence of putrefying pus in the mastoid antrum, and which may eventually lead to necrosis or caries of the temporal bone. There is also a form of chronic proliferation of bone which is no doubt a result of inflammation, and ends in the complete filling up of all the pneumatic spaces by solid bone. This process may be accompanied by very severe pain, which, however, seems generally to be relieved by surgical attempts to reach the mastoid cells.

In all cases of mastoid disease the condition of the patient gives rise to anxiety. In chronic middle ear suppuration pain usually means tension, while tension in cavities so near the brain, and large vessels separated from them only by delicate partitions, means danger.

Our efforts must accordingly be directed towards the relief of tension. In the first place, we must see that the natural channel for the outflow of pus is open. If the meatus be blocked by a polypus or inflammatory swelling, the former must be removed or the latter incised. It may happen that in cases of mastoid inflammation the pus finds its way under the periosteum of the posterior wall of the bony meatus, so that an incision in this region is often called for.

If the canal be free, douching with a hot solution of bicarbonate of soda is useful, and Politzer has lately advocated the injection of warm fluid through the Eustachian catheter. While these points are being attended to, leeches should be applied behind the ear, and if these fail to give relief a free incision should be made down to the bone, parallel to the attachment of the auricle, and about half an inch behind it, in order to avoid the posterior auricular artery. The knife in making the cut should be drawn from below upwards,

to prevent its slipping into the tissues of the neck. Before the case is brought to the surgeon a large abscess may have formed behind the ear. An opening should then be made in the most dependent part, and it will often be desirable to keep the wound open for a time with drainage tubing, whilst slight pressure is applied by means of dressings.

If, in spite of the treatment indicated, the pain goes on unabated, and head symptoms threaten, it will be necessary to open the mastoid cells, or if a fistula already exists, to enlarge it. For this operation a chisel or small trephine may be used; and as the chief danger consists in wounding the lateral sinus, the instrument should be directed forwards rather than backwards.

In all cases of mastoid disease caries or exfoliation of necrosed bone is liable to occur, and it may be necessary to assist the latter process on general surgical principles.

During the acute stage it is often well to administer a sharp purge, and a strictly antiphlogistic regimen should be observed, with rest in bed, and, of course, avoidance of stimulants.

Ice applied to the affected side of the head, and painting the mastoid process with tincture of iodine, is a form of treatment which in the very early stages may be successful in aborting the attack, but I much prefer to apply leeches at once. During these attacks of mastoid inflammation the temperature may rise considerably above the normal, the pulse is quick, and the tongue furred. The danger to be feared is death from phlebitis of the cerebral sinuses, abscess of the brain, or meningitis.

CARIES OR NECROSIS.

Caries and necrosis of portions of the temporal bone, while rare as a result of chronic disease confined to the meatus, are not very uncommon as a complication of chronic suppuration of the middle ear.

Gruber¹ estimates the relative frequency with which various parts of the temporal bone are attacked as follows:—(1) The mastoid process. (2) The roof of the tympanic cavity. (3) Posterior wall of the external meatus, in which case the affection is, however, generally secondary to middle ear disease. (4) The plate of bone separating the mastoid cells from the lateral sinus. (5) The floor of the tympanum and the posterior wall of the carotid canal. (6) The petrous portion proper, containing the labyrinth. Very commonly the auditory ossicles are alone attacked, and one or more of them may be exfoliated.

It will be readily understood that in some instances the diagnosis of caries or necrosis is easily made. Thus, if there be a fistulous opening over the mastoid, with its orifice surrounded by exuberant granulations, and if the probe reveals the presence of bare or roughened bone, nothing can be simpler. We may also find what seems to be a polypoid mass in the meatus, most usually growing from its upper and posterior wall, which by careful examination is found to be a mass of granulation tissue, springing from the mouth of a sinus. The mastoid region may become swollen and fluctuating in the course of chronic middle ear suppuration; and inspection of the meatus, while pressure is made on the abscess, may reveal the presence of a communication between the latter and the auditory canal.

In cases like these the diagnosis is easy, but when

¹ *Lehrbuch der Ohrenheilkunde*, pp. 534, 535.

the deeper parts are involved, we are at once deprived of the use of the probe as a means of diagnosis. Certainly it is sometimes employed, but such practice must be adopted with great care and skill when the suspected bone lesion is within the cavity of the tympanum.

Pain is often most distressing in deep-seated caries, but it is not a constant symptom, and may be due to other causes. Paralysis of the portio dura, coming on in the course of chronic otorrhea, must be looked upon with suspicion, but may be only transitory and caused by inflammation of, or pressure upon, the nerve sheath, the osseous covering of which is sometimes defective even in the healthy ear.

In most cases of caries of the tympanic walls exuberant granulations will be found in large quantity. If the labyrinth be attacked, of course the tuning-fork test will furnish an important diagnostic aid. Cases are on record where the whole internal ear has been exfoliated during life.

The quality of the discharge sometimes aids the surgeon in arriving at a conclusion as to the presence of caries. If it be watery and peculiarly offensive, we must look upon these facts as suspicious, although foetor alone is commonly met with in all—even the simplest—cases of neglected otorrhea. Chemical analysis of the exudation, with a view to finding excess of lime salts, is very well in theory, but of doubtful practical value. A microscopic¹ examination may, however, sometimes prove useful, by showing the presence of bone spicules in the discharge. In the treatment of caries we must, of course, attend scrupulously to cleanliness by frequent syringing with boracic lotion. Both for cleansing purposes and for relief of pain, warm injections through the Eustachian tube have been found useful by Politzer.

¹ Gruber, *op. cit.*

Probably in most cases caries is due to chronic suppuration occurring in a subject debilitated by exhausting illness or constitutional taint. Treatment should therefore be directed towards counteracting any special dyscrasia (syphilitic, strumous, etc.), or remedying general weakness.

Where it can be done with safety, diseased bone should be removed. Sometimes to do so it is necessary to open the mastoid cells or enlarge an already existing fistula. Opiates may be required if only to produce temporary freedom from tormenting pain. Gruber has found relief given by the application of the actual cautery over the mastoid region. Urban Pritchard¹ has recently advocated a method of treatment which consists in the injection of very diluted mineral acids by means of the syringe. In his hands a fair measure of success seems to have followed this procedure. Before using acid injections it would, I imagine, be essential to remove every trace of pus, otherwise an impenetrable layer of coagulated albumen would prevent contact between the acid and the diseased bone upon which it is desired to act.

MENINGITIS AND CEREBRAL ABSCESS.

Both complications may supervene in cases of otorrhea in which the bone is diseased. Abscess may also result where no signs of caries or necrosis can be detected *post mortem*, and indeed sometimes pus is found separated from the meninges by a portion of healthy brain substance. In one case² I found, on making sections of the bone in the neighbourhood of the tympanum, that it was literally infiltrated with bacteria.

¹ *Brit. Med. Journ.* 1882.

² 'The Pathology of a Case of fatal Ear Disease,' by P. M'Bride and A. Bruce, *Journ. of Anat. and Phys.* vol. xiv.

Of seventy-six cases¹ of cerebral abscess collected by Gull and Sutton, twenty-seven were traceable to ear disease, and Lebert² believes that disease of the temporal bone was the exciting cause in one quarter of all published cases.

In the course of chronic middle ear suppuration rigors, headache, and increased temperature should give rise to grave fears of cerebral complication, while the presence of photophobia, sluggish pupils, and, above all, optic neuritis, render the existence of intra-cranial mischief all but certain. At a later stage, of course, delirium, coma, and paralysis may supervene. The pulse is usually rapid at first, then becomes gradually slower, and rises in frequency before death, in cases of meningitis. However, space does not permit of further allusion to the diagnosis of diseases which are fully described in all works on the practice of medicine.

Treatment is usually of little avail if either of the lesions under consideration have become established, yet cases are recorded in which symptoms pointing strongly to cerebral disease (optic neuritis among the rest) have been successfully met and combated. It is of primary importance to wash out the ear frequently with boracic lotion, and to remove any obstruction to the egress of pus. To fulfil this indication it may even be necessary to open the mastoid cells. Leeches should, I think, also be applied freely over the mastoid if any tenderness exist in this region, and a free incision through skin and periosteum may be called for to relieve tension. A purge is useful if it be given early, and ice bags should be applied to the head. Indeed, the general treatment should be that of meningitis or abscess as described in works on medicine.

¹ 'A System of Medicine,' Reynolds, vol. ii. ² Virchow's *Archiv.*, 1856, 106.

EROSION OF LARGE VESSELS.

Occasionally a carious process leads to erosion of either the jugular bulb or the internal carotid artery. This is not very common, but hæmorrhage from the carotid,¹ ending fatally, has been described in several cases. I had under my care, some years ago, a patient who was suffering from caries of the temporal bone, and whose death was sudden, and accompanied by profuse bleeding from the ear. A *post-mortem* examination was, unfortunately, not obtained; but from the description of the bleeding given by those present, I had little doubt that rupture of the internal carotid was the cause of death.

So far as I know, all such cases have terminated fatally, on account of the rich anastomosis between the vessels supplying the cranial cavity. It is, I think, open to question whether the common carotid can be ligatured with even the slightest chance of success, for we cannot cut off the blood supply from the brain without causing death; and if the cerebral circulation is to go on, blood will soon find its way to the internal carotid artery, either by way of the vessel of the opposite side (if it be not also ligatured) or the vertebrals. It is obviously impossible to tie all these vessels and yet maintain life.

PHLEBITIS.

Phlebitis may occur in cases of chronic middle ear suppuration, the vessels first involved being usually the lateral sinus or jugular vein. In the former case

¹ For full details of these, consult *Archiv. f. Ohrenheilkunde*, vol. xviii. p. 1, 'Ueber Arrosion der Arteria Carotis interna,' etc., by Hessler.

there is said to be œdema, involving the region between the mastoid and occiput, while if the jugular be involved, there is swelling of the side of the neck, and great tenderness in the course of the vein. The general symptoms are furred tongue, rigors, and intermittent fever of a typhoid character. Metastatic abscesses are likely to form in internal organs before death. In addition to local attention to the ear disease, the internal administration of quinine and the sulpho-carbolates is indicated, and stimulants are usually required to prolong life.

CHAPTER VII.

CHRONIC NON-SUPPURATIVE INFLAMMATION OF THE MIDDLE EAR.

UNDER this head a vast number of pathological conditions are included, but in all cases there is deafness, and the tympanic membrane is preserved entire, although it may be altered in a variety of ways, *e.g.* in (1) position, (2) lustre, (3) thickness, (4) mobility.

In all these cases, too, which we consider under this category, the pathological condition is due to a more or less slow inflammatory process in the Eustachian tubes or tympanum.

There can be no doubt that a very large proportion of patients owe the lesion to the extension of a catarrhal process from the naso-pharynx, along the Eustachian tubes, into the drum cavity. Whether we are justified, however, in using the term catarrhal in all the various forms hereafter to be described is, I think, doubtful. It must be remembered that within the tympanum there are other structures besides the mucous membrane which lines the cavity and covers the ossicles. There are, for instance, the joint between the malleus and incus, and the articulation between the stapes and fenestra ovalis, which often suffer, becoming either ankylosed or stiff. We know that such diseases as gout and rheumatism attack joints in other parts, and

why should those within the drum cavity escape? In syphilis, chronic middle ear inflammation is apt to arise, causing a form of deafness which presents all the clinical features of catarrhal cases, with the one exception that the process of thickening within the tympanum advances much more rapidly, and leads the observer to suspect that the morbid process is more of the nature of periostitis than catarrh. On all these points, however, our information as to pathological anatomy is deficient, as it must be in all non-fatal diseases. It is true that many specimens of chronic middle ear disease have been obtained, but in comparatively few cases can they be associated with that exact clinical history, which would so much enhance their value. As before said, however, the ear affection we are considering can often be traced to a catarrhal affection of the naso-pharynx.

In a typical case the patient at first suffers from a chronic affection of the throat, the only symptoms of which are slight dryness and discomfort. As a rule, too, he requires—owing to nasal catarrh—to use his pocket-handkerchief frequently. If the throat be examined in the early stage, the mucous membrane is found to be red and swollen. The tonsils, especially in children, are often hypertrophied, and the nostrils discharge a quantity of mucus. Deafness sets in more or less gradually, and is accompanied by little or no pain, while tinnitus aurium or vertigo—more especially the former—is by no means rare if the patient be an adult. Now what is the condition of parts which leads to deafness? In the early stages the symptom is produced by swelling and hyperæmia of the mucous membrane lining the Eustachian tubes. Gradually this swelling and hyperæmia may extend and affect the tympanum, involving to a greater or

less extent all its contents. Mucus, too, may be poured out, and add another impediment to the free movement of the auditory ossicles, already clogged by the swollen mucous membrane which surrounds them. It sometimes happens that instead of a mucous exudation, the tympanum—usually when the morbid condition has lasted for some time—contains a straw-coloured serous fluid. When this stage has been reached it follows, almost as a matter of course, that the disease cannot remain *in statu quo*. The swelling and hyperæmia may diminish, any exudation that has been formed may become absorbed, and the parts return to their normal state, once more becoming able to fulfil their function. In many cases, however, instead of progressing towards a cure, the hearing goes from bad to worse, or at best remains unimproved. The swollen mucous membrane becomes permanently, and, as I think, incurably thickened; adhesions form in various parts; the ossicles, more especially the stapes, become more or less fixed, and the hearing is permanently impaired. As a general rule, the mucous membrane forming the inner layer of the drumhead is also involved, as shown during life, by a general or patchy opacity. Many authors believe that the exudation, which has been poured out in the early stages, may become inspissated, and in its dried-up state produce clogging of the ossicles and deafness. I am disinclined to attribute primary importance to this as a pathological factor of the symptom in question; for if the living membrane return to health, it follows that morbid secretions will become absorbed, while, on the other hand, if fibrous thickening and adhesions result, their presence is sufficient to account for the deafness. We have thus traced chronic middle ear catarrh, spreading from the pharynx along the Eustachian tubes, from its commencement in swelling and hypersecretion

to its termination in thickening of the mucous membrane and the formation of adhesions.

In some cases, however, the pharyngeal catarrh is not marked, and even the Eustachian tubes are not affected. The morbid process seems to have little tendency to hyperæmia and hypersecretion, but passes at once into the formation of fibrous tissue, resulting in thickening and adhesions. Often this gradual proliferation of tissue seems to begin in the inner wall of the tympanum, where it involves the stapes and fenestra rotunda, or fixes the incus without affecting parts which are directly accessible to examination. When this is the case we can only arrive at a diagnosis by a process of exclusion, and even then the actual part affected cannot always be made out.

As to the etiology of chronic non-suppurative inflammation, it can only be repeated that it generally results from chronic pharyngitis or from nasal catarrh. It follows that diseases which tend to cause these conditions may sow the seeds of middle ear disease. In most cases, however, the mucous membrane of the throat or nose is primarily affected, and the inflammatory process then extends by degrees along the Eustachian tubes.

The progress of chronic non-suppurative inflammation is, as before hinted, often modified by syphilis. Middle ear deafness due to syphilis is, so far as I have been able to observe, accompanied by slight objective changes and marked impairment of hearing, while the tuning-fork is heard best in the bad ear, provided the labyrinth be not also affected. Again, it may be that the arthritic diathesis also modifies the disease under consideration in the manner before suggested, quite apart from the fact that a rheumatic pharyngitis may involve the tympanum by extension along the Eustachian tubes.

According to Von Tröltzsch, heredity is an important factor, and it is quite possible that in one person there may exist a tendency to ear catarrh, just as in another the 'part of least resistance' is the apex of the lung. Although we shall study the subject of chronic non-suppurative middle ear disease under several headings, yet it may not be amiss here to glance at the general symptoms of the disease. The most important of these is the gradual onset of deafness unaccompanied by pain, both ears being usually affected, while one is generally more deaf than the other. Sometimes the patient complains of tinnitus aurium only, being unaware of any impairment in the hearing power. Many persons whose hearing is much impaired are perfectly unconscious of the fact, while they are acutely alive to distressing noises in the head. If such patients admit that they are deaf, they usually say that the tinnitus drowns all other sounds, whereas, in reality, the same pathological changes, which impair the hearing, originate directly or indirectly the subjective noises. It is a noteworthy fact that children hardly ever complain of tinnitus. In most cases of tympanic catarrh the tuning-fork when applied to the middle line of the head is heard better in the deaf ear. It occasionally happens, however, that owing to the changes in the middle ear, temporary paresis of the auditory nerve occurs, as a sequence of abnormal tension of the intra-labyrinthine fluids. Sometimes in an ear which has become completely deaf, loud sounds produce a painful sensation, this symptom being spoken of as hyperæsthesia acoustica.

Another phenomenon which is only marked in those who are very deaf, is ability to hear better when surrounded by noise. This is probably always associated with stiffening of the ossicular joints, more especially

fixation of the stapes, and is known by observers to be of very unfavourable prognostic significance.

Vertigo—from a slight chronic feeling of giddiness to absolute inability to stand—may owe its origin entirely to middle ear catarrh, and, what is more important, is often amenable to purely local treatment. Loss of memory and a feeling of tension about the head are sometimes complained of. In very slight cases, the patient may seek relief from ‘a stuffiness in the ears,’ and only a careful examination will reveal impairment of hearing.

We shall now consider the clinical forms or types of chronic non-suppurative which may be met with, basing our classification as much as possible on pathology.

SIMPLE CATARRHAL INFLAMMATION.

Under this heading I shall describe a class of cases in which the organ may return to perfect health. There is chronic swelling and hypersecretion of the mucous membrane lining the pharynx and Eustachian tube. This condition not unfrequently extends to the tympanum, where mucus may be exuded.

Such is, shortly, the pathology of the most common cause of deafness in children. It is also sometimes met with in young adults, but rarely in middle or advanced age.¹

The pharynx is always more or less congested; the tonsils are generally hypertrophied, and there is a large amount of nasal discharge, with swelling of the mucous membrane, covering the inferior turbinated bones. As a result, respiration through the nostrils is impeded, and the patient is apt to acquire a habit of keeping the

¹ Pain in the course of this affection indicates an attack of subacute inflammation, which should be treated on the lines laid down in the chapter on acute inflammation.

mouth open to facilitate breathing, and from the same cause there is often snoring during sleep. Deafness which is marked, is increased by catching cold, *i.e.* when from exposure or other cause the naso-pharyngeal catarrh is aggravated. Probably debilitated and strumous children are more liable than others to this form of disease, although it is frequent in the rosy and robust. Children rarely complain of either tinnitus or vertigo, while the deafness is usually at first set down to inattention by their parents or teachers.

Occupying the vault of the pharynx between the orifices of the Eustachian tubes, there is, even in health, a certain amount of adenoid tissue (pharyngeal tonsil). Sometimes this hypertrophies, hangs down in polypoid masses,¹ and causes mechanical obstruction to the entrance of air into the Eustachian tubes. Hypertrophied tonsils never directly cause obstruction of the tubes, but, by the irritation they produce, tend to keep up the catarrhal condition of the adjacent parts.

To return to the actual cause of deafness, the catarrh of the naso-pharynx produces swelling, and consequently obstruction of the Eustachian tubes at their pharyngeal orifices. No fresh supply of air can enter the tympanic cavity, and the existing supply is soon absorbed. The pressure of the external atmosphere then acts upon the outer surface of the drum membrane, forcing it inwards. The upper part of the malleus, *i.e.* the short process, is fixed by ligaments, but the handle and lower part of the membrane sink inwards, while the membrana flaccida, situated above the short process, is also depressed. Consequently the malleus is foreshortened and supports two sharply defined folds, of which the posterior is the more marked (Plate VII. A).

¹ These are generally spoken of as adenoid vegetations or adenoid tumours of the naso-pharynx.

When the catarrhal process has also affected the lining membrane of the tympanum, the drum membrane is often reddened, and its lower portion may even be slightly bulged.

If air be forced into the tympanum either by Politzer's method, one of its modifications, or, if necessary, the Eustachian catheter, a more or less moist sound may be heard by means of the auscultating tube, and subsequent inspection shows that the membrane has been forced into a position more or less approaching the normal. If the hearing power be now tested, it will be found that it is much improved. This is especially the case if the catarrh be confined to the faucial orifices of the Eustachian tubes. The improvement is at first, however, only temporary, but by its amount and duration we are enabled to form an accurate prognosis.

The treatment consists in—(1) removing the cause, and (2) remedying its effects.

If the patient be delicate, a course of cod liver oil and syrup of the iodide of iron will be found useful. The general health must be improved, and the catarrhal tendency controlled. A dry bracing climate, where it can be obtained, is extremely serviceable, as are baths and good hygienic surroundings.

The local treatment varies a little according to circumstances. Thus, if an examination of the nares reveals the presence of polypi, their removal should be undertaken at once. If adenoid growths be suspected to exist, and if the suspicion be confirmed by a digital or rhinoscopic examination, they should, if of considerable size, be removed by means of suitably curved forceps with cutting edges, as used by Löwenberg and Woakes. If the tonsils be much enlarged, it is sometimes desirable to remove a portion by means of the guillotine.

In ordinary cases, however, the following treatment will usually meet all requirements :—

(1.) Washing out the nostrils by syringing through the inferior meatus a slightly warmed solution of salt (3i to the pint), borax, bicarbonate of soda, or tannic acid, if a more astringent application be desired. An anterior nasal spray is also a very efficient substitute for the syringe.

(2.) Gargling the throat with a similar solution, or one containing alum and chlorate of potash. Both syringing the nostrils and gargling should be repeated thrice a day.

(3.) Painting the throat once a day, the brush being carried well towards the roof of the pharynx, with a solution of nitrate of silver (gr. x. ad 3i), chloride of zinc (gr. xv.-xxx. ad 3i), or glycerine of tannin.

(4.) The daily use of Politzer's bag for a fortnight. The treatment then to be intermitted for a week or fortnight, and if necessary resumed.

For the treatment of these cases, provided the patient and relatives be intelligent, only an occasional visit to the surgeon is necessary. With definite instructions and one or two demonstrations most people can learn to use the air-bag well and efficiently, more especially if the nose piece be one of Allen's pads (Appendix, Plate II. C); and the patient having once experienced the sensation of air entering the drum will know whether subsequent inflations are successful. Of course there are some obstinate cases which require to be seen daily for a short time, but they are not numerous. In the affection we are considering it is not often necessary to use the Eustachian catheter. Whatever method of using the air douche be employed, it is necessary to guard against too long continued injections, lest the drum membrane become unduly relaxed.

ADVANCED CASES OF CHRONIC MIDDLE EAR CATARRH.

Under this head we shall consider cases in which the process of hypersecretion has given place partially or entirely to the formation of fibrous tissue. In these cases the disease is usually of long standing, and therefore more common in people who have passed early youth. Deafness, coming on more or less gradually, at first varying, but after a time constant, is the common clinical history. Distressing tinnitus, which is frequently compared to the sound of a sea shell, but may resemble strokes of a hammer, or even ringing of bells, is present, while vertigo may add to the discomfort of the patient. As before stated, hearing may be better in a noisy place, and this is of unfavourable import.

This form of middle ear catarrh has been spoken of as one in which the process of hypersecretion has given place more or less to the deposition of fibrous tissue, but it must be remembered that in many cases the stage of excessive secretion is not such as to excite attention. As a rule, however, there is more or less evidence of inflammation in the pharynx, and hawking up of mucus in the morning, and dryness of the throat, are complained of. Examination of the pharynx may reveal more or less uniform redness, passive engorgement of the vessels, or an uneven surface, the result of inflammatory changes.

The rhinoscopic mirror will often enable us to detect swelling of the mucous membrane about the orifice of the Eustachian tubes, over the inferior turbinated bone, nasal septum, and roof of the pharynx; or the presence of masses of viscid mucus in the posterior nares.

In forming a diagnosis of the condition of the tympana and Eustachian tubes, we depend upon the following points:—

- (1.) The appearance of the tympanic membrane.

(a) Colour; (b) position; (c) changes produced by inflation and suction by means of Siegle's pneumatic speculum.

From the colour of the membrane we may sometimes gather valuable information. Thus, if the malleus be clearly visible, and the membrane presents opacities in various parts (Plate VII. F), we conclude that these are the result of thickening of the internal mucous membrane layer, or of the substantia propria. At the same time, it must not be forgotten that limited patches of thickening do not necessarily interfere with the hearing power, and that they may be the remains of acute processes in early childhood. It is comparatively rare that a membrane is met with of which we should be entitled to say that the amount of thickening in it is only consistent with the presence of very great deafness.

Not unfrequently we meet with atrophy of portions of the drumhead. These atrophic patches are thinner than the surrounding membrane, into which they gradually shade off. Sometimes they seem dark, while often they are so transparent that the parts behind can be distinctly recognised (Plate VII. B); after the air douche the atrophied portion often bulges towards the meatus (Plate VII. C). Cicatricial patches, the result of a perforation healing by second intention, have the same features with the one exception, that instead of shading off into the surrounding healthy membrane, their line of demarcation is sharply defined (compare Plate VI. B, C). Atrophy occurs in cases in which there is or has been obstruction of the Eustachian tubes, the constant excess of pressure on the outer surface then leading to thinning of the drumhead.

The shining spot is often altered in shape, or even absent, in cases of chronic catarrh, or several bright patches may be present, one being very commonly seen above and behind. All we can gather from such changes

is that some abnormality of the membrane is present, affecting either its lustre or position.

If the Eustachian tube be obstructed, the membrane tends to assume the position and appearance which have already been described. Sometimes the folds, more especially the posterior, become very prominent, as a result of the indrawing of the lower portion. The manubrium mallei not unfrequently becomes adherent to the promontory (inner wall of tympanum) when the condition has lasted for a long time. Such an adhesion can be diagnosed by inspecting the membrane while air is forced into the middle ear, or during suction with the pneumatic speculum, when the movable portions are seen to approach the eye, leaving the fixed point behind.

In a number of cases the indrawing of the membrane is not so marked, but a careful examination will show an undue prominence of the short process (upper extremity) of the malleus.

(2.) In all cases where the examination of the tympanic membrane does not afford definite data, we must trust to a careful examination by means of the auscultating tube and inflation.

While the surgeon's ear is connected with that of the patient by means of a tube, air is forced into the tympanum by means of the Eustachian catheter, or if that instrument cannot be used, by Politzer's method (preferably Holt's modification). It must be noted whether the current (1) enters the tympanum freely, (2) whistles through a narrow dry tube, or (3) passes in with a moist rattle.

The information so gained will enable the observer to judge approximately whether the mucous membrane of the Eustachian tube be in a state of moist swelling, or whether the inflammation has advanced to the stage of dry thickening, and by analogy he may be entitled

to assume the existence of a similar condition of parts within the tympanum.

Before going farther, it will be well to look more in detail at the possible factors of deafness in the class of cases we are considering, and the effect likely to be produced upon each by means of the air douche.

(1.) *Obstruction of the Eustachian tube.* So far as deafness is due to this cause alone, it can be entirely removed, if but temporarily, by opening the tube and supplying air to the middle ear.

(2.) *Diminished tension of the membrane from atrophy.* By means of the air douche this condition can also be removed, but only for a short time.

(3.) *Swelling of the mucous membrane within the tympanum from infiltration of cell elements,*—and, as a matter of course, the presence of more or less free exudation. So much of the deafness as may depend upon the secretion will probably be removed for a time by the action of compressed air. The sharp and sudden current will scatter the fluid, and probably relieve the clogged ossicles, enabling them to fulfil their function.

(4.) *Fibrous thickening in various parts, e.g.* the membrane,¹ the joints of the ossicles, the annular ligament of the stapes, the membrane of the fenestra rotunda, or adhesions where their presence impairs the functions of the membrane and ossicles. When the inflammatory process has advanced to this stage, it is obvious that the air douche can only cause improvement by acting upon delicate adhesions which can either be stretched, or ruptured, by this means.

The general conclusions we are entitled to arrive at from the preceding data are that the prospect of improvement is good in those cases in which the air douche

¹ Thickening of the membrane is probably a very rare cause of deafness except as associated with other factors.

produces temporary improvement, and that the longer such improvement lasts the better is the prognosis. When, after several repetitions on different days, the air douche, aided by local medication of the nasopharynx, produces no change, we must suspect the existence of fibrous thickening in a situation where it cannot be acted on by compressed air, and must give an unfavourable prognosis accordingly.

The amount of tinnitus present aids our prognosis somewhat. For if the subjective noises be constant, the prospect of cure is—other things being equal—worse than if they be intermittent; on the other hand, if the air douche relieves the tinnitus, the prognosis is more favourable.

There is a group of cases, all of which, strictly speaking, should not be included under this heading, because in some of them the inflammatory process has not gone on to the development of fibrous tissue. I allude to those in which free fluid can be distinctly seen through the membrane. When the drumhead shows, at its lower part, a yellow colour separated from the upper normal coloured portion by a dark line (like a hair), and when this line changes its position as the head is moved, strong evidence of the presence of free fluid within the tympanum is afforded (Plate VII. D). If the middle ear be inflated, a marked change occurs, and the yellow colour may disappear entirely, only to return again after a short interval. Frequently the air mingles with the fluid, and we see behind the membrane circular bubbles, while auscultation may yield a sound as if air were driven through fluid (Plate VII. E). The yellow discolouration may be only evident in parts where the membrane is atrophied, or may first show itself after inflation. Mr. Hinton,¹ in his work on aural surgery,

¹ *Questions of Aural Surgery.*

described a number of cases in which incision of the membrane gave exit to masses of tough mucus; but his cases, as they are recorded, seem, most of them, to have been subacute rather than chronic. The presence of thick mucus may be suspected if the membrane is opaque and traversed from centre to periphery by numerous radiating vessels. In arriving at a conclusion whether any abnormal appearance—*e.g.* opacity—be due to the presence of foreign matter in the tympanum, or to changes in the substance of the membrane, we are aided by inspection before and after the air douche. In the former case a change would probably be observed, while in the latter the appearance before and after the injection of air would be exactly the same.

INFLAMMATION NOT EVIDENTLY CATARRHAL.

As a third group, must be considered those cases in which the Eustachian tubes are freely open, the nasopharynx normal, and in which all history of previous throat catarrh is wanting. This form of disease is spoken of by authors as dry catarrh (Von Tröltsch), proliferous inflammation (Roosa), and otitis media hypertrophica (Gruber). The two last-mentioned terms are more in accordance with our knowledge of its etiology than the former. It is indeed very doubtful whether a catarrhal inflammation has anything to do with the gradual process of thickening in these cases. The part which seems to suffer most frequently is the stapedio-vestibular articulation, which often becomes rigid. Toynbee considered the arthritic diathesis as a factor of importance in producing this condition, and I am, from my own experience, inclined to the same opinion. The other joints connecting the ossicles may, however, also suffer, while the fenestra rotunda may be blocked by adven-

titious fibrous matter, and adhesions, too, may form in various situations.

This form of deafness usually occurs after middle life, except when—as is often the case—the cause is syphilis or hereditary predisposition. The first symptom noticed is often tinnitus,—more rarely vertigo,—while the hearing is impaired so gradually that the duration of deafness cannot be discovered with any certainty. This symptom is also as a rule unimproved by the use of compressed air, which sometimes indeed makes the hearing temporarily worse.

The tympanic membranes are normal in colour and position, although Von Tröltzsch has noticed an irregularity in the outline of the malleus; but the value of this observation is doubtful, since exactly the same condition may be found in an ear with perfect hearing power.

The pathological process can only be localized in the middle ear by means of the tuning-fork test, but as the disease is one of advanced life, even this sometimes fails.

The phenomenon of hearing better in a noise, when it occurs, is probably connected with deficient mobility of the ossicles, more especially the stapes.

Bing¹ of Vienna has lately suggested an ingenious method of distinguishing between fixation of the malleus and incus on the one hand, and of the stapes on the other. In the former case, according to Bing, the patient is deaf to words spoken into the ear, but can hear those spoken into the Eustachian catheter; while, in the latter case, he can hear by neither method. As the treatment and prognosis of this form of deafness does not, in the present state of our knowledge, differ from that of advanced catarrh, we shall, in the following chapter, consider both together to save needless repetition.

¹ Politzer, *Lehrbuch der Ohrenheilkunde*, p. 215.

CHAPTER VIII.

TREATMENT OF ADVANCED CASES.

IN those cases in which the naso-pharynx is in an unhealthy state we must begin by treating this condition. If the nostrils are obstructed, and the mucous membrane swollen, the injection of an alkaline, or slightly astringent, solution through the inferior meatus will prove serviceable. The surgeon may, according to circumstances, use a lotion containing common salt, bicarbonate of soda, borax (ʒi to a pint), or tannin (grs. i.-iii. ad ʒi). A still more effective method of making applications to the nares consists in the use of the anterior nasal spray. An alkaline solution for cleansing purposes, followed immediately by an astringent, will in many cases be found a most efficient means of treating nasal inflammation. Thick mucus and crusts are thus washed away, leaving a clean surface, upon which the astringent takes effect. If the latter be applied to a surface coated with mucus, it in most cases forms an impervious layer of coagulated albumen—a result not to be desired.

If a rhinoscopic examination reveals the presence of inspissated mucus on the roof of the pharynx or turbinated bones, it may also be desirable to employ the posterior nasal spray, using here also an alkaline followed by an astringent application.

It is in most cases advisable to prescribe a gargle,

and one containing chlorate of potash and alum, or a solution of common salt, will usually be found to meet all requirements. The method of gargling recommended by Von Tröltsch¹ is much superior to that commonly practised. It consists in allowing the gargle to fall back into the pharynx as far as possible, and then performing the act of swallowing without letting the fluid go over, for by this means the muscles acting upon the Eustachian tubes are brought into action and exercised.

If the naso-pharynx be in a distinctly catarrhal state, stronger applications are often required. These should be made by means of a bent brush passed behind the soft palate towards the Eustachian tubes. From my own experience, I believe that the most generally satisfactory pigment for this purpose is one containing ten to twenty or more grains of nitrate of silver to an ounce of water. Chloride of zinc (gr. xxx. ad ʒi), perchloride of iron (ʒi ad ʒi), or glycerine of tannic acid may, however, often be found useful.

What was previously said concerning hypertrophied tonsils, adenoid vegetations, and nasal polypi can only be repeated here.

We must now turn to treatment through the Eustachian tubes. There can be no doubt that in the treatment of chronic middle ear catarrh, as in its diagnosis, the injection of compressed air is one of the most efficient means at our command. Let us consider for a moment the therapeutic effect of injecting air into a middle ear, in which catarrhal swelling of the tubes and mucous lining, with hypersecretion, exists. In the first place, air is restored to the tympanic cavity, and the membrane, unless bound down by adhesions, is forced outwards into its proper position.

¹ *Lehrbuch der Ohrenheilkunde*, p. 372.

Then it must also be borne in mind that the existence of rarefied air tends to favour exudation, while gentle pressure promotes absorption. This gives a second indication for treatment, which is fulfilled by the use of the air douche. Moreover, the sudden current of air tends to scatter what secretion has already formed, and thus renders its absorption more easy.

In all cases in which the Eustachian tube is obstructed, it is the surgeon's duty to endeavour to restore its normal calibre, for the ear is thus placed under the most favourable condition for cure; and even where this possibility no longer exists, the progress of the inflammatory process may be checked by removing those physical conditions which favour it. This indication can generally be fulfilled even in the most obstinate cases by the use of the catheter. Sometimes cases are met with in which the injection of air renders the hearing distinctly worse, and these are probably to be explained on the supposition that the membrane is rigid and unyielding, so that the full force of the compressed air is exerted on the fenestræ; the use of bougies passed along the Eustachian tube may then be justifiable.

The application of the air douche by no means necessitates constant visits to the surgeon; for, as before stated, unless in very obstinate cases, Politzer's bag can be used perfectly well at home, provided always the patient be kept under observation, so that undue relaxation of the membranes is guarded against. When one ear only is affected, however, the use of the catheter may be rendered necessary, as it is often undesirable to act upon the healthy organ.

When forcing air into the middle ear is not followed by any improvement, the deafness is often due entirely to the presence of fibrous thickening, adhesions, or

even ankylosis of the ossicles. It is then recommended by some eminent authorities to inject small quantities of fluid into the tympanum, and for this purpose a great variety of solutions have been used, but those most in vogue are iodide of potassium, bicarbonate of soda, or chloride of ammonium, from five to ten grains being dissolved in an ounce of water. In order to make the injection, a small syringe is used, the nozzle of which fits into the Eustachian catheter (Appendix, Plate II. H). A few drops are thus injected, and driven onwards by means of the air-bag. Another, but less safe, method is that suggested by Gruber,¹ which consists in forcing the fluid into one nostril by means of a syringe, while the other is closed. As a result of the elevation of the palate produced by reflex action, the posterior nares are shut off from the pharynx, and the fluid is driven through the Eustachian tubes; by this means much larger quantities can be carried into the middle ear, so proportionately weaker solutions must be used.²

It is claimed that such injections tend to cause absorption of fibrous tissue by establishing a slight reaction; but it is somewhat difficult to credit this, for would even the most sanguine believer in the deobstruent action of the iodide of potassium expect a result from injecting a five, or even ten grain (to the ounce) solution into a urethra having in its course an organic stricture? If not, can we expect a more satisfactory result in the case of adventitious fibrous tissue within the tympanum? There is no doubt that the injection of a few drops of fluid through the Eustachian catheter often tends to allow the current of air to pass more freely

¹ It is safer in all cases to use warm solutions, although when only a few drops are injected this is not essential.

² *Lehrbuch der Ohrenheilkunde*, p. 261.

through the tubes, and it may be that in this fact lies the explanation of the benefit said to be derived from fluid injections. Sometimes we learn from auscultation that free mucus is present in the Eustachian tubes, and the injection of a weak solution of sulphate of zinc (gr. ii. or gr. iii. ad 3i) through the catheter may then be found useful.

Medicated or even simple steam may not unfrequently be employed in advanced cases, and it is often recommended to inject the vapour through the Eustachian catheter. A simpler method, however, consists in first, if necessary, securing patency of the Eustachian tubes by means of this instrument, and then directing the patient to take the steam into the mouth and perform Valsalva's experiment.* Although neither this form of treatment nor any other can cure cases in which deafness or tinnitus is due to fibrous thickening or ankylosis, yet it will sometimes relieve. A useful routine prescription is as follows:—

R.: Tinct. Iod.

Ether. acet. āā ʒss.

M.

Sig. Twenty drops to be put into a pint of hot water, and the steam used as directed (*i.e.* by Valsalva's method).

The directions given are—(1) to use the steam only at bedtime, in order to avoid subsequent exposure to cold; (2) to make only two or three inflations at a sitting; (3) not to continue this treatment longer than a fortnight without intermission. This last caution is very necessary, as otherwise undue relaxation of the membranes might ensue.

The vapour of chloride of ammonium is sometimes injected through a vulcanite catheter, and is said by Von Tröltzsch¹ to be of value when the mucous membrane lining the Eustachian tubes is swollen and moist.

¹ *Lehrbuch der Ohrenheilkunde*, p^r 351.

* Valsalva's experiment should not be recommended to persons with a weak or diseased heart. (See *A Rare Form of Laryngeal Neurosis*, by the author.—*Transactions of the Edin. Med. Chir. Soc.*, 1884.)

Vapour of turpentine—which requires no special apparatus¹—has also been found useful by Politzer² as a remedy for this condition. Dr. Buck³ has recently suggested the use of counter-irritation over the mastoid process in cases which give evidence of vascular engorgement, as shown by the presence of dilated vessels behind the malleus.

The appropriate constitutional treatment varies somewhat according to the nature of the case. If the ear disease be catarrhal in its origin, it is necessary to guard against 'catching cold.' In exceptional cases the surgeon may see fit to send his patient to a warm dry climate, or, as suggested by Politzer,⁴ a residence in an Alpine district may prove beneficial. Cold or tepid baths, and avoidance of sitting in damp clothes or wet stockings, are points which need only be mentioned to be attended to. Small doses of cod-liver oil in winter seem sometimes to counteract the catarrhal tendency, while chloride of ammonium is by many considered as more or less of the nature of a specific; but its efficacy is open to doubt. Good results seem occasionally to have followed the use of small doses of perchloride of mercury, with or without the addition of strychnine. To patients in whom a rheumatic tendency exists, more especially if the middle ear disease is not dependent upon naso-pharyngeal disease, iodide of potassium may be given, while this drug should certainly be exhibited if there be a history of syphilis.

We must now consider some of the operative procedures which have been suggested to meet special pathological conditions usually resulting from chronic non-suppurative inflammation of the middle ear.

¹ The bag is emptied and allowed to refill itself from a bottle which contains turpentine, care being taken that none of the fluid is sucked up.

² *Lehrbuch der Ohrenheilkunde*, p. 336.

³ *American Journal of Otology*, April 1882.

⁴ *Op. cit.* 342.

(1.) *The Removal of Free Fluid from the Tympanum.*

As already stated, cases are met with in which the surgeon can diagnose with absolute certainty the presence of free fluid in the tympanum. In many such, excellent results may be obtained by treatment directed to the naso-pharynx, and by establishing patency of the Eustachian tubes in the ordinary way. Sometimes, however, it is found that in spite of every care only a temporary improvement can be produced by these methods, and attempts must then be made to remove the fluid by more mechanical means. The following methods have been adopted for this purpose:—

(a) *Suction by means of a tympanic catheter* (probably the least satisfactory). A small tube is passed through the Eustachian catheter and Eustachian tube into the middle ear, while suction is applied at its free extremity.

(b) *Politzer's method*, which consists in inflating the ear, while the head is bent forward and towards the side opposite to the ear upon which it is desired to act. This has the effect of, for the time, converting the anterior wall of the tympanum into the floor; and if the Eustachian tube be then opened, the fluid, if it be not viscid, will tend to gravitate downwards into the pharynx.

(c) *Incision of the membrane.* There can be no doubt that under some circumstances this operation is of the utmost value. It is indicated in chronic cases in which there is known or suspected to be fluid in the middle ear, and in which the symptoms are not materially or permanently benefited by other treatment. The instrument best suited for making an incision in the membrane is Gruber's paracentesis knife (see Appendix, Plate III. D), which should, like all instruments used for operating on the deeper parts of

the ear, be attached to the handle at an angle, so that the hand may not obstruct the operator's view. The forehead mirror must of course be used to throw in light, while the left hand supports the speculum. The incision should be made in the posterior inferior quadrant, as at this point the membrane is farthest away from the inner wall of the tympanum. Afterwards the ear must on no account be syringed, but the exudation should be driven into the meatus by means of the air-bag, with or without the catheter, and then dried up by means of absorbent wool. The patient is directed to keep the meatus stopped with cotton wool for a day or two, and to avoid smoking and drinking. This operation, even if it does not prove beneficial, is usually quite harmless, and not very painful,¹ and the wound generally heals within a day or two without further trouble. For the beginner the difficulty lies in judging the distance with one eye, and thus a cut is often made in the walls of the meatus instead of the membrane.

(2.) *Attempts to keep a Permanent Opening in the Membrane.*

At present one of the great problems which exercise the minds of otologists is the possibility of establishing a permanent opening in the drum membrane.

In spite of the knowledge that perforations made by disease often defy our efforts to heal them, the fact remains that it has hitherto been found impossible to keep artificial perforations from closing, whether by the insertion of an eyelet (Poltzer), an aluminium tube (Votolini), or other means. Even after excision of the whole membrane it is replaced by cicatricial tissue, so that the problem is as far from solution as ever, and it

¹ An anæsthetic is rarely required.

would serve no good purpose here to detail the various unsuccessful efforts which have been made to solve it.

The class of cases which would be benefited, and are temporarily relieved, by the presence of a perforation so long as it remains, are, according to Politzer¹—(1) great thickening of the membrane; (2) fixation of the malleus and incus, while the stapes retains its mobility; (3) absolute closure of the Eustachian tube; (4) some cases of tinnitus.

(3.) *Section of the Posterior Fold.*

In cases where the membrane is much indrawn and the posterior fold very marked, and in which simpler means of treatment have failed, this operation has been practised. It is justified on the grounds that it is harmless, while it often gives temporary relief from tinnitus, and sometimes improves the hearing power, although, as a rule, the benefit is but transient. The operation is easily performed by cutting through the fold from above downwards with Gruber's knife (Appendix, Plate III. D, a).

(4.) *Tenotomy of the Tensor Tympani.*

This is an operation which may be said to be yet on trial, although a considerable time has now elapsed since Weber Liel first performed it. As matters at present stand, the profession have a right to ask for further proofs of its efficacy than have yet been given. It is necessary, before accepting it as useful, to know exactly how much of the good result described in certain cases was due to the presence of an opening in the membrane, and how much to section of the tendon. To describe the steps of the operation is unnecessary, more especially as Politzer² has recently expressed the opinion that 'Tenotomy of the tensor

¹ *Lehrbuch der Ohrenheilkunde*, p. 431.

² *Ibid.* p. 443.

tympani may be classed among those operations which not only do little good, but also sometimes produces deleterious effects upon the auditory function.'

(5.) *Section of the Anterior Ligament of the Malleus.*

This is an operation which has recently been introduced by Politzer.¹ It is performed by cutting the anterior fold of the membrane and then passing a blunt-pointed and sickle-shaped instrument through the wound. The concave margin of the knife has a cutting edge, which is turned upwards and pressed against the structure to be divided. So far the results of the operation, in cases in which the drumhead was much indrawn, and in which a marked but short-lived improvement was produced by the air douche, have been satisfactory.

(6.) *Treatment of Abnormalities of Tension in the Drum Membrane.*

Curiously enough, multiple incision has been recommended by Gruber in cases in which the drum membrane is abnormally tense, and by Politzer when it is abnormally relaxed. The last-named condition, characterized by unnatural mobility either during inflation or suction by the pneumatic speculum, is not uncommon. It has been recommended by some to excise a portion of the membrane in these cases, or even to burn a piece out by means of the galvanic cautery. Such a proceeding may, however, prove dangerous to life by setting up acute inflammation of the tympanum, and I doubt whether sufficient improvement to compensate for this risk is ever obtained.

A more satisfactory method of treating relaxed membrane is that suggested by Dr. M'Keown,² which consists in applying collodion to the part, and thus

¹ *Op. cit.* p. 438.

² *British Medical Journal*, 1879.

gradually restoring its tension. In cases of indrawn membrane of long standing, which resist ordinary treatment, I have found it useful to apply collodion immediately after using the air-bag so as to give support.¹

(7.) *Synechotomy (severing of Adhesions).*

It is quite conceivable that cases may arise in which the aurist is justified in attempting to separate an adherent membrane from the inner wall of the tympanum. For this purpose either a small rectangular instrument or a miniature iridectomy knife may be used. Dr. Woakes² has sought to arrive at the same result by means of an instrument which he terms the 'Pneumatic Tractor.' The principle consists in exercising powerful suction on the membrane through the meatus. Some continental aurists have, however, gone much farther. The malleus and incus have been extracted so as to admit sonorous vibrations more directly to the stapes; and in cases where the latter has been found ankylosed, operative attempts have been made to restore its mobility.³

The time may come when many operations which are at present of doubtful propriety because of the impossibility of forming an exact diagnosis, will be perfectly justifiable, but in the present state of our knowledge the surgeon should reflect well before he goes farther than incising the membrane or cutting the posterior fold. Neither of these operations can do much harm, and the former is often productive of great benefit; of some of the others which have been referred to, it is, however, impossible to say as much.

¹ This is easily done by means of a probe round which cotton wool is twisted. The latter is then saturated with collodion and the membrane painted.

² *Deafness, Giddiness, and Noises in the Head.*

³ Kessel was the first to suggest this operation. For details, see *Archiv für Ohrenheilkunde*, vol. xvi. p. 196 (review by Birkner).

CHAPTER IX.

TRAUMATIC LESIONS.

THE auricle, from its exposed position, is liable to be bruised or cut, and must then be treated on general surgical principles. The external meatus may be injured either by direct or indirect violence—more usually the latter. A blow on the lower jaw may drive the ramus against the osseous portion of the auditory canal with such force as to produce a fracture in this situation. A longitudinal fissure sometimes exists as a complication of fracture of the base—in which cases there is usually, also, a rent in the tympanic membrane. To quote from Politzer: ‘On the whole, then, fractures of the meatus are rarely confined to this region, but are generally complicated by fissures of the upper or inner tympanic wall, the mastoid process, the petrous portion of the temporal bone, and the base of the skull.’¹

If a pointed instrument be driven into the ear, the drum membrane is, of course, ruptured, but the labyrinth, and even the membranes of the brain, may also be wounded. Cases are on record in which a large quantity of cerebro-spinal fluid flowed from an ear so injured.

A blow on the ear, or even a loud sound in its

¹ *Lehrbuch*, p. 752.

immediate vicinity, may cause rupture of the membrane, concussion of the labyrinth, or both injuries at once. Whether a healthy drumhead is often injured in this way must remain extremely doubtful, after the experiments of Gruber and Schmiedekam.¹ It was found that a pressure of 143 and 168 cm. of mercury respectively was required to rupture two membranes which had lain but a short time in spirit; and again, that a pressure of four or five atmospheres applied through the Eustachian tube and external meatus was insufficient in other cases. It often happens, however, that from deficient ventilation of the tympanum and inflammatory changes in the drumhead, the parts are in an unhealthy state, and predisposed to injury; atrophic or chalky membranes are therefore particularly liable to rupture.

Great care is requisite in forming a diagnosis and prognosis when deafness results from such accidents as have been enumerated. In the first place, the vibrating tuning-fork should be applied to the middle line of the head or teeth, and if its vibrations be better perceived in the injured ear, it is safe to conclude that the labyrinth is intact. If not, there is reason to fear that the internal ear has been injured either by fracture or concussion.

In cases of labyrinthine injury, where deafness is absolute, no improvement is to be expected; in others, some amelioration, or even restoration of perfect hearing power, may be hoped for, but should never be promised. At the time of injury, such symptoms as nausea, giddiness, and even loss of consciousness, often occur, while distressing tinnitus, which may become permanent, is usually experienced. The same symptoms may accompany simple rupture of the drum membrane, while momentary pain and a feeling of something giving

¹ Gruber, *Lehrbuch der Ohrenheilkunde*, p. 333.

way are also experienced. Inspection will also reveal the presence of coagulated blood on some part of the membrane, and if air be forced through the tympanum, the edges of the opening will be seen to gape; while if, during the process, the auscultating tube be used, a characteristic perforation murmur¹ will be heard. If there be reason to fear that the lesion has extended to the membranes of the brain, the prognosis is, of course, grave in the highest degree.

Certain cases of labyrinthine concussion most certainly improve. The hearing power may by degrees return, and the subjective sensations of sound gradually cease. Other cases are, however, quite incapable of deriving the slightest advantage from treatment. Indeed, it is questionable whether the physician can contribute anything towards the result, when it is remembered how inaccessible to our remedies is the internal ear.

The application of iodine to the mastoid process, the internal administration of iodide of potassium, together with the use of electricity, after a sufficient interval has elapsed, would at least comprise a rational course of treatment.

When the drum membrane is ruptured the patient should be directed to avoid alcohol and tobacco, the diet should be non-stimulating, and the ear stopped up with cotton wool. The most important point in the treatment of traumatic perforation is avoidance of fluid instillations or injections, which are sure to cause inflammation of the middle ear. If these be avoided, and the course of treatment already recommended be adopted, the perforation will usually heal within a few days. If, unfortunately, pain sets in, a cold compress over

¹ The sound corresponds to that caused by blowing through a hole in a piece of paper.

the ear, and the application of two leeches—one in front of the tragus and the other over the mastoid—may abort the threatened inflammation. Should suppuration or serous discharge occur, the case must be treated as one of acute inflammation of the middle ear. In cases of fracture of the base, the danger to life is so great that the ear lesion becomes a matter of secondary importance, and in many of these cases the patient is left permanently and incurably deaf.

Bezold has lately recorded a most interesting case, in which a punctured wound, avoiding the ear, passed through the Eustachian tube, and after cicatrisation caused complete obstruction and consequent deafness (*Berlin. Klin. Wochenschrift*, October 1883).

CHAPTER X.

MALIGNANT DISEASE.

As we have seen, epithelioma may attack the auricle, and is then to be diagnosed and treated on general surgical principles.

A considerable number of cases are, however, recorded in which malignant growths have first made their appearance in the meatus. Most of these seem to have originated in the cavity of the tympanum, or to have reached the ear by extension from neighbouring parts, and then to have appeared in the external auditory canal after perforating its walls, or after making their way through the drum membrane.

Occasionally the meatus is attacked first, the ulcerative and destructive process if unchecked soon involving the tympanum and adjacent parts. Politzer states¹ that epithelioma in this situation may first manifest itself as an eczema, which is soon replaced by destructive ulceration. Sometimes a small painful nodule is the first objective sign; and in a case reported by Delstanche² the patient was at the beginning of her fatal illness treated for furuncle of the meatus. When the middle ear is attacked either primarily or secondarily, it is often extremely difficult to differentiate between caries and malignant disease, more especially as the latter seems by preference to attack those who

¹ *Lehrbuch*, vol. ii. p. 742.

² *Archiv für Ohrenheilkunde*, p. xv.

already suffer from chronic suppuration of the tympanum. In most of the recorded cases the patients seem in the first place to have complained of otorrhea. Examination of the meatus then revealed granulation tissue, or a polypoid mass of considerable size. Severe hæmorrhage often followed the removal of such adventitious masses, which recurred very rapidly. Fluctuating swellings in the neighbourhood of the ear, when opened, discharged unhealthy, bad-smelling matter, and not unfrequently a fungous mass made its appearance at the seat of incision. In other cases exfoliation of necrosed bone took place.

Paralysis of the facial nerve often occurs in the course of this disease; and if the growth has either extended into the cranial cavity or originated there, various other nerves may become implicated. When the labyrinth has become involved, the patient can no longer hear the vibrating tuning-fork through the cranial bones in the affected ear.

It is obvious from what has been said, that the only means of arriving at a definite diagnosis is to examine a portion of the tumour microscopically; for symptoms similar to those produced by this disease in its earlier stages may owe their origin to caries, which, if complicated by cerebral abscess, may cause paralysis of various cranial nerves. The pus discharged from an ear affected by malignant disease is peculiarly offensive, and often tinged with blood; glandular swellings are commonly met with in its neighbourhood, while so much of the tumour as can be removed is rapidly reproduced. All these conditions may, however, be simulated by affection of the bone, associated with the presence of exuberant granulations. So far, most of the tumours observed have been found to consist either of epithelial cancer or of sarcomatous tissue. Schwartz has minutely

described a case of epithelioma, probably originating in the mucous membrane of the tympanum, in a man aged fifty-five;¹ while Pomeroy² has recorded with equal care the history of a child, six years of age, who died of intra-cranial myxosarcoma, which first became visible in the external meatus, after it had perforated the membrana tympani.

Cancer of the upper jaw may implicate the Eustachian tube, and in this way cause deafness, due to inward displacement of the drumhead.³ Most cases are of course hopeless from the beginning; but if a limited epithelioma is found in the meatus, the use of a sharp spoon, followed by the application of chloride of zinc, or some other caustic, is indicated.

¹ *Archiv für Ohrenheilkunde*, vol. ix.

² *Diseases of the Ear*, 1883.

³ Politzer, *Lehrbuch*, ii. p. 744.

CHAPTER XI.

THE LABYRINTH AND AUDITORY NERVE.

IN an elementary work it would serve no good purpose to detail all the different morbid conditions which have been found and described in the labyrinth and auditory nerve.

Besides undergoing various chronic and degenerative changes, the membranous labyrinth is liable to be injured by violence (usually indirect), and to be the seat of hæmorrhage or effusion of lymph. The internal administration of certain drugs, too, such as quinine and salicylate of soda, may cause deafness, due to temporary changes either in the auditory nerve, labyrinth, or brain. The auditory nerve, either at its centre or in its course, may be the seat of pathological changes, or may be pressed upon by tumours. Chronic non-suppurative inflammation of the middle ear is very apt to cause secondary lesions in the labyrinth; and in the course of caries of the temporal bone the internal ear may become diseased, and its osseous capsule destroyed.

Let us now turn to a consideration of our subject viewed from a practical and clinical standpoint.

Unfortunately our present methods of examination do not enable us to distinguish between disease of the auditory nerve at its terminal organ (the labyrinth)

and lesions affecting it in its course. In most cases we are enabled to draw conclusions from other sources, but not always. The latter will in many cases depend upon intra-cranial tumour; and then the presence or absence of optic neuritis, and other signs of cerebral disease, will aid the practitioner in arriving at a diagnosis.

Nerve deafness may be primary, or secondary to middle ear mischief. In the first case its advent is more or less sudden, the affected ear becoming deaf in the course of a few days, or even hours. Secondary lesion of the labyrinth is more common than primary, and usually results from chronic non-suppurative inflammation of the tympanum, which has lasted for a long time, or which is rapidly progressive. Of course it is very difficult in these cases to form an opinion as to how much of the deafness is due to lesion of the labyrinth, and how much to the condition of the middle ear.

Absolute deafness, when it occurs, may be looked upon as pathognomonic of nerve deafness, as even in the most aggravated cases of middle ear inflammation there is left a certain amount of hearing power, but fortunately we do not meet with this in all cases.

The sudden onset of deafness, accompanied by giddiness, is just ground for suspecting primary disease of the internal ear, but our sheet-anchor in diagnosis is the tuning-fork test. The physiology¹ of this experiment has already been discussed, so that it will suffice to recapitulate shortly the most important facts.

(1.) If a patient hears the tuning-fork placed on the middle line of the brow, teeth, or inferior maxilla less distinctly with the deafer ear, or if both ears be involved, does not hear it at all, there are grounds for

¹ Chapter II.

suspecting nerve deafness, superadded to middle ear affection, or alone.

(2.) The same is true if, when the tuning-fork has ceased to be heard through the bones of the head, its vibrations can be perceived when placed opposite the meatus.

(3.) If the nerve be involved, the tuning-fork when it has ceased to be heard by the patient may still be audible to the surgeon if placed upon the forehead, thus proving that the sound-perceiving organs of the former are less sensitive.

When the labyrinth is suddenly attacked, the patient usually manifests the symptoms of auditory vertigo in a marked degree. Giddiness, nausea, vomiting, cold sweats, and sometimes loss of consciousness—to which we shall allude further in another chapter—occur, accompanied by tinnitus aurium. When these symptoms, together with deafness, which the tuning-fork test shows to be labyrinthine, set in suddenly, we know that the morbid process has involved the whole internal ear (*i.e.* both semicircular canals and cochlea).

It sometimes happens, however,—according to Roosa,¹ most commonly in syphilitic cases,—that the patient is attacked by noises in the head and deafness, but not vertigo. In these cases Roosa considers that we are entitled to speak of an inflammation, or, at all events, a lesion confined to the cochlea.

More recently, a still further refinement in diagnosis has been arrived at. It was briefly explained in a preceding chapter that physiologists now consider that the lower portion of the cochlea—*i.e.* that nearest the tympanum—is concerned in the perception of high notes, while the scale gradually falls as the cupola is approached. Moos examined a patient carefully as to

¹ *Diseases of the Ear*, p. 523.

his power of hearing different notes, and found that on one side high notes were not heard, while lower tones could still be perceived. A subsequent careful examination of the cochlea after death revealed atrophy of the nerve in the first turn. It will be seen from this case that it may in certain circumstances be of value to test the power of perception through the cranial bones with tuning-forks of different pitch.

DISEASE OF THE LABYRINTH SECONDARY TO
MIDDLE EAR AFFECTIONS.

This is most commonly met with in advanced cases of chronic non-suppurative inflammation of the tympanum. If the diseased action goes on unchecked, a stage is usually arrived at which is characterized by very great deafness and deficiency or absence of perception of the tuning-fork through the cranial bones, while the power of modulating the voice is impaired owing to inability of the patient to appreciate the tones produced. Such cases are generally spoken of as secondary complications of the internal ear. At the same time, it seems not at all improbable that a morbid process—which, for instance, renders the stapes and membrane of the fenestra rotunda immovable—must more or less impede vibration of the fluid contained within the internal ear. In cases of this kind the prognosis is very bad, but attempts at treatment should not forthwith be abandoned. If, in accordance with the rules laid down in a previous chapter, there be a reasonable prospect of checking or benefiting the primary middle ear disease, treatment should be attempted; and if tinnitus aurium or giddiness be troublesome, the palliatives suggested in a later part of this work should be used.

Cases may also be met with in which obstruction of

the Eustachian tube produces, as it were, a paresis of the auditory nerve. The drum membrane is pressed inwards, and this pressure is communicated to the stapes, thus producing a change of tension in the fluids of the internal ear. Deafness, and often giddiness, are so caused, and may often be relieved by suitable treatment.

Again, in acute inflammation of the tympanum, a secondary congestion of the inner ear may take place, producing impaired power of hearing through the cranial bones, which soon disappears under appropriate remedies directed against the primary cause.

MENIÈRE'S DISEASE.

Hyperæmia of the labyrinth may occur in the course of various acute diseases, producing deafness, and, if the patient be not too prostrate to notice it, a feeling of vertigo. Deafness occurring after serious loss of blood is probably due to anæmia either of the auditory centre or labyrinth.

Sudden hæmorrhage into the labyrinth, or, as it has been more generally called, Menière's Disease, is a much less common affection than is generally supposed, but when it does occur is easily recognised. The patient—whose hearing was before perfect—is suddenly attacked with tinnitus and deafness in one ear, while he not unfrequently falls down from intense vertigo. The giddiness is followed by nausea, faintness, and cold perspiration. An examination of the ear gives no objective results, and the vibrating tuning-fork is not heard by bone-conduction on the affected side. The giddiness sooner or later passes off, while the tinnitus often abates in intensity; but the hearing power of the affected ear is irrevocably lost in most cases. Politzer

has pointed out that the disturbance of equilibrium is increased by closing the eyes, or in the dark.

In effusion of blood into an organ so remote as the labyrinth, it seems to me extremely doubtful whether anything can be done to hasten or promote the process of absorption by local applications. Rest, cold cloths to the head, antiphlogistic regimen, and the administration of a cathartic, would seem rational treatment in an affection so nearly allied to apoplexy. Quinine, recommended by Charcot, should be used, if at all, with extreme caution, as it may affect the sound ear. Bromide of potassium to alleviate the vertigo, and at a later stage the iodide to promote absorption, may be given. Politzer advises the subcutaneous injection of pilocarpin to be begun during the second or third week after the attack (four to ten min. of a two per cent. sol. to be used daily). The same author advises the injection of a solution of iodide of potassium through the Eustachian catheter, and the use of electricity.

SYPHILIS OF THE INTERNAL EAR.

At the risk of anticipating what is to be said in a later chapter, it is necessary here to call attention to the subject of labyrinthine syphilis.

The internal ear may be attacked at almost any stage of the disease. Deafness—with or without giddiness, according as the whole labyrinth or only the cochlea is involved—comes on rapidly, accompanied by tinnitus. Both ears are often affected, and the tuning-fork is heard either imperfectly or not at all. Roosa has recorded an interesting case of a syphilitic patient in whom deafness and giddiness, accompanied by facial paralysis, yielded to anti-syphilitic treatment.

The probable lesion here was effusion around the auditory and facial nerves.

The treatment must of course be conducted on general principles, *i.e.* by the use of anti-syphilitic remedies. Sometimes—as in the experience of Politzer—mercury is most effective, while Roosa seems to have had the best results from the administration of the iodide of potassium, which in one case was taken to the extent of 369 grs. in a day. Politzer also advises the subcutaneous injection of pilocarpin. Counter irritation over the mastoid, and electricity, may be tried, but the prognosis is bad as regards the recovery of hearing.

BOILERMAKERS' DEAFNESS.

There can be no doubt that when the ear is frequently exposed to loud sounds, as in the case of boilermakers, artillerymen, etc., the often repeated concussion of the labyrinth tends at last to cause deafness. Not unfrequently the labyrinthine lesion is associated with middle ear catarrh, which makes the organ of hearing a '*locus minoris resistentiæ*.' The loud sound acts primarily by driving the drum membrane inwards, and with it the stapes. It is obvious that if, owing to Eustachian obstruction, the air within the tympanum be rarified, this will be more easily and more fully accomplished, and thus the common association of boilermakers' deafness with tympanic disease is probably to be accounted for. In these cases the deafness is generally associated with tinnitus, but vertigo is not common.

The prophylaxis consists in avoiding the cause, or, if this be impossible, in stopping up the meatus before entering the factory; while disease of the middle ear,

when present, must be treated on the principles suggested in a previous chapter.

RHEUMATIC AFFECTION OF THE AUDITORY NERVE.

So far as I am aware, only a few cases of this affection have been recorded. The most marked of these was observed by Bing.¹ A woman, aged forty-seven, after exposure to cold, became suddenly quite deaf in the right ear, while the hearing power of the left was considerably impaired. The tuning-fork was only heard on the left side, and objectively no change in the drum membranes could be detected. The patient recovered after about a week, the only treatment used being the internal administration of iodide of potassium and the application of vesicants over the mastoid.

Deafness due to cerebro-spinal meningitis, hysteria, and cerebral tumours will be considered in a subsequent chapter.

ELECTRICITY IN EAR DISEASE.

In his work on diseases of the ear,² Politzer distinguishes three methods by which electricity may be applied to the organ of hearing, viz. :—

(1.) The internal method, in which the ear is filled with a solution of salt, into which the electrode is dipped.

(2.) The external method, in which the electrode is simply applied over the meatus.

(3.) The intra-tubal method, which is used by Woakes and Weber Liel, one electrode being inserted into the Eustachian tube.

To these three methods we may add the application of the current directly to the drum membrane, as recommended by Mr. Field.

¹ *Wiener Med. Wochenschrift*, 1880, quoted by Politzer.

² P. 838.

For the intra-tubal method special instruments have been invented, first by Weber Liel, and subsequently by Woakes.

The value of electricity in the treatment and diagnosis of ear disease is not as yet well defined. Some aurists reject this agent altogether, while others report good results from its use. In his great work on electricity, Duchenne¹ records some cases which seem to show that there are forms of deafness in which electrical treatment may prove decidedly beneficial.

Brenner has given an elaborate formula, describing the reaction of the auditory nerve to the constant current; but as his views are far from generally accepted, I refrain from quoting them.

Woakes² and Weber Liel³ have described forms of middle ear deafness depending upon paresis of the palate muscles, in which the intra-tubal application of electricity is indicated. Others have, however, looked upon these cases as merely forms of what we have considered as chronic non-suppurative middle ear inflammation; and it is quite possible that in electricity we may find a useful method of ventilating the middle ear through its power of causing contraction of those muscles which open the Eustachian tube. It has always seemed to me difficult to reconcile the views of these two authorities; for while Weber Liel assumes that paresis of the palate muscles causes antagonistic contraction of the tensor tympani, Woakes asserts that in the form of deafness described by him there is paresis both of the palate muscles and the tensor tympani.

While much doubt as to the efficacy of electricity as a curative agent in deafness exists, still it cannot be

¹ *De l'électrisation localisée*, pp. 825, 826.

² *Deafness, Giddiness, and Noises in the Head*.

³ *Progressive Schwerhörigkeit*.

denied that its use is occasionally followed by relief in some forms of tinnitus aurium, although even here its application is somewhat empirical. To relieve subjective auditory phenomena, Mr. Field, in the manner indicated above, uses the induced, while continental authorities seem to prefer the constant current. Whatever form of electricity is used, however, and for whatever purpose, great caution should be exercised, both by beginning with a very weak current, and by stopping the application on the first indication of giddiness or other unpleasant symptoms. Of late I have come to the conclusion that there exists a distinctly neurasthenic group of cases in which electricity is indicated, and which I have elsewhere described as nervous deafness.¹

NERVOUS DEAFNESS.

While it is comparatively rare to find deafness due entirely to functional anomalies of the nervous system, yet cases are recorded in which sudden emotion has caused complete and sometimes permanent deafness. Scanzoni noticed very marked but transient impairment of hearing after leeching the cervix uteri.

Few persons, even the most vigorous, have not at some time experienced that languor which is best described by the term atony. If this condition be analyzed, its symptoms can only be explained on the hypothesis that from diminished nerve force the centres and peripheral nerves are less active. Now want of activity of the nerves and nerve centres means a temporary and very slight paresis, in which all the nerves will share, and among the rest the auditory nerve.

¹ *Lancet*, 1881.

In an individual whose hearing is otherwise perfect the slight impairment so produced will not be appreciable, but the case is very different if the patient be already deaf from some organic change. Thus we do not, as a rule, find this functional impairment complained of except by those whose ears are in a pathological condition.

In the present state of our knowledge we are, I believe, entitled to assume the presence of functional variations in the auditory nerve in patients who are already deaf from organic disease (in the middle ear or labyrinth), and in whom the hearing varies under circumstances which cannot alter the pathological condition. When this is the case, and if the patient be seen during an exacerbation of deafness, we can sometimes give relief by means of electricity and nerve tonics. Among the causes which I have found to produce temporary diminution in the perceptive power of the auditory nerve, are dyspepsia, general depression, and the like. In conclusion, I shall record a typical case.

E. W. æt. 43. Consulted me first some years ago. At that time it was noticed that electricity produced a marked improvement; treatment of the naso-pharynx was also employed, but, unfortunately, a daily record of the progress was not kept. In February 1883 the patient again came to Edinburgh, when I had the opportunity of carefully reinvestigating her case. She had been deaf to her knowledge for years, but in '78 or '79 had very severe neuralgic pains, and thinks that from that time the hearing got worse. The deafness was increased by sore throat, to which the patient is rather subject. She has had tinnitus of the sea-shell variety, but not constant or very troublesome. There was no vertigo, and menstruation was regular. When excited she *felt* a lump in her throat, the pharynx

was slightly anæsthetic, and in phonation the uvula was drawn to the right.

Hearing distance (for watch normally heard at 30 inches)—

Left ear—contact.

Right ear—just off the auricle.

The tuning-fork through the cranial bones best heard in the left ear.

Tympanic membranes very slightly concave, but otherwise normal. Eustachian tubes pervious. Valsalva's inflation rendered hearing worse.

An induced current only strong enough to produce pricking was used for a few minutes at each visit—the sponges being applied over the tragus on both sides with the following results :—

After first application, slight improvement.

After second application, 11th Feb., hearing power, L. just off the ear. R. $\frac{1}{2}$ inch.

After third application, 12th Feb., hearing power, L. $\frac{1}{2}$ inch. R. $\frac{7}{8}$ inch.

After fourth application, 13th Feb., hearing power, L. $\frac{3}{4}$. R. 1.

After fifth application, 15th Feb., hearing power, L. 1. R. $1\frac{1}{8}$.

23rd Feb. Patient began to take phosphorus $\frac{1}{38}$ gr. twice daily.

4th March. Hearing power, L. 1 inch. R. $1\frac{1}{4}$.

11th March, „ „ L. 1 inch. R. $2\frac{1}{4}$.

After this galvanism was tried for the last time, before the patient left, with the result of improving the hearing distance on the left side by $\frac{1}{4}$ inch.

Evidently this case was originally one of advanced chronic non-suppurative inflammation of the tympanum, and so far as the deafness was due to this cause it was probably incurable.

The course of events was, I believe, as follows. The patient's hearing power was so impaired by the tympanic disease that any slight additional defect would be severely felt. An atonic condition of the nervous system then occurred, which superadded to the disease of the sound-conducting apparatus an auditory nerve less capable of conveying impressions,—in fact, a neurasthenic condition of the auditory nerve as a part of a general neurasthenia. The anæsthesia of the palate and the occurrence of a lump in the throat during excitement, furnish other signs of a weakened nervous system.

Some might consider these sufficient to prove the case to be one of hysteria; but the fact that the patient was a remarkably intelligent and sensible woman, and showed no other hysterical symptoms or tendencies, negative this view. Moreover, I have seen the electric treatment, as used in this case, and under similar indications, produce good results in patients of the other sex, in whom hysteria was not to be thought of.

CHAPTER XII.

ARTIFICIAL AIDS TO HEARING—SIMULATED DEAFNESS— LIFE INSURANCE—DEAF-MUTISM.

THE various forms of conversation tube and ear trumpet are too well known, alike to the practitioner and to the public, to deserve discussion in a work where economy of space is an object.

The instruments in most common use are the ordinary conversation tube, which has a conical mouthpiece, while the other extremity is adapted so as to fit the meatus, and bell-shaped metal trumpets, which are often found useful for hearing in public buildings. Some deaf persons hear much better when the auricle is pressed forwards, and its reflecting surface enlarged by the aid of the open hand. Instruments on this principle are sold extensively, and sometimes aid the wearer; by ladies these may be concealed under the head-dress. The best method of securing an efficient instrument is to allow the patient to try a large number of different kinds, and to select the one found most convenient. Endless varieties are usually to be seen in the shops of surgical instrument makers, so a detailed account of their structure is unnecessary.

For reading aloud an ingenious suggestion is made by Von Tröltzsch.¹ An ordinary conversation tube is

¹ *Lehrbuch der Ohrenheilkunde*, 1877, p. 581.

supplied, with a very large mouthpiece, which is placed upon a table opposite the reader's lips. Politzer has recently introduced a small hearing tube, which has the merit of being invented by a scientific otologist, and the use of which is based upon physiological research. This author found, experimentally, that if the surface of the tragus be increased by the addition of a small rigid plate, the hearing power is increased, and he has accordingly used small curved tubes—somewhat trumpet-shaped at one end. The instrument is introduced so that the convexity corresponds to the concavity within the tragus, and the trumpet-shaped opening points backwards. Politzer has had some very good results from the use of these little tubes, which, from being painted pink, and from their small size, can be worn without attracting attention. I have recently tried them, in one case only was the result at all satisfactory.

The audiphone, lately introduced with great *éclat*, has not been found to warrant in any degree the expectations of its inventor. The instrument consists of a plate of vulcanite (or other substance) bent upon itself by means of a string. When in use the edge of the plate is applied to the upper incisors, the convexity being turned towards the speaker, and vibrations are thus conducted through the cranial bones to the labyrinth.

The dentaphone is another instrument differently constructed, but on the principle of the audiphone. The general consensus of opinion seems to be that these instruments sometimes aid deaf patients, but are on the whole inferior to the conversation tube, though, at the same time, a few instances have been recorded in which the audiphone was found to be decidedly useful.

Another modification of the same principle is that

suggested by Paladino. A metal rod is so adapted that one end may be held between the teeth, while the other is applied to the larynx of the speaker. Politzer¹ says of this instrument, that it might prove useful in 'patients who do not hear speech through the conversation tube, but who can without it understand words spoken loudly in the immediate neighbourhood of the ear.'

SIMULATED DEAFNESS.

It may be of service to detail a few of the means which have been suggested for the detection of pretended deafness. When one ear only is said to be affected while the other is perfect, detection is easy by one of the following methods:—

(1.) Let the good ear be stopped with cotton wool, and afterwards apply the vibrating tuning-fork to the head. The malingerer will often state that he does not hear a sound, being unaware of the fact that an obstructed meatus intensifies the vibrations conducted to the labyrinth through the cranial bones (Moos).

(2.) If one ear be perfect, even after it has been stopped up with cotton wool, words will be heard if shouted close to the patient. A malingerer, however, will, under these circumstances, often deny his ability to hear a sound.

(3.) Let the patient be blindfolded, and both ears be furnished with conversation tubes, while words are whispered by two persons alternately into first one and then the other. If one ear be really quite deaf, only those spoken into the good ear will be heard. In a case of pretended deafness the patient will commit himself sooner or later by repeating words

¹ *Lehrbuch der Ohrenheilkunde*, ii. 877.

which have been whispered into the ear supposed to be deaf.

(4.) Coggin¹ has suggested the use of the binaural stethoscope, so modified that either branch can be hermetically closed at will. The malingerer being unaware of this fact, will be unable to tell what he ought to hear, and thus detection is ensured.²

If total bilateral deafness be feigned, detection is more difficult. Making the suspected individual repeat the history of his case frequently may enable the observer to detect discrepancies in the statements. Politzer considers that the best test is afforded by the amount of sound required to awaken the suspected person from sleep. It has also been suggested to administer chloroform, and then to address the patient just as he is returning to consciousness, and while he can be taken unawares.³

LIFE INSURANCE.

Generally speaking, chronic affections of the external ear alone are not in themselves dangerous to life. Yet the existence of a chronic discharge from the meatus, even if no perforation of the membrane be discovered, should be looked upon with suspicion. The presence of a large exostosis, blocking up the canal, should, I think, make the person so affected pay a higher premium; for if the patient were attacked with suppuration, either in the meatus behind the growth or in the tympanum, disastrous results might arise from the pent-up exudation.

More common than any of these conditions is

¹ *Zeitschrift für Ohrenheilkunde*, viii. 294.

² The ear pieces are inserted into the ears of the patient, while the practitioner speaks into the other end.

³ For further information, see Politzer, *loc. cit.* 845; Urbantschitsch, *Lehrbuch der Ohrenheilkunde*, p. 536.

chronic suppuration of the tympanum with a perforated membrane. When this exists, the life should either be refused or only taken at an increased rate. It is true that a large number of persons who have had chronic otorrhea all their lives die of some complaint not in any way associated with the ear disease. At the same time, the surgeon cannot, in any given case, estimate the risk, which, in simple cases, and when the perforation is of fair size, may be roughly put down as equal to that incurred by a hernia patient. In both, attention (to cleanliness in the one case, and to keeping up the bowel in the other) will probably ward off serious consequences, while neglect may be fatal; but it must be remembered that it is much easier to ensure the use of a well-fitting truss, than to be certain that the affected ear will be cleansed several times daily. If, in addition to the presence of a perforation, there be reason to fear that the egress of pus may be prevented, the danger is increased manifold. A very small perforation, with copious otorrhea, occasional attacks of pain, the presence of granulations or a polypus, would, in my opinion, warrant rejection. Perforations situated in the membrana flaccida being often associated with caries, come under the same category.

It is almost needless to remark that any signs or symptoms pointing to disease of bone render rejection imperative.

It is a fact worthy of the attention of medical referees, that persons may suffer from otorrhea and still be unaware of the fact. In such patients the discharge is not sufficiently copious to run out of the meatus, but stagnates in its deeper parts. The use of a speculum will, of course, readily detect this condition.

As we have before seen, chronic middle ear suppuration may, after the discharge has ceased, leave a permanent opening in the membrane. When this happens, suppuration is very apt to recur from the slightest exposure, or as the result of cold water getting into the tympanum.

Persons who suffer from auditory vertigo, more especially if they be sailors, slaters, etc., are exposed to an extra amount of danger from their tendency to fall without warning.

DEAF MUTES.

There are two forms under which deaf-mutism may occur—(1) congenital, (2) acquired.

The congenital variety depends either upon defective development of the auditory apparatus or upon intra-uterine ear disease. It is most commonly due to heredity, but has also been ascribed to other causes, *e.g.* consanguineous marriages, bad hygiene, drunken parents, etc.

Acquired deaf-mutism is found in persons who, having become deaf in the earlier years of life, have either failed to learn to speak, or who after being able to talk have lost the power of speech. According to Politzer,¹ children who become deaf before the age of four almost without exception become dumb, while in loss of hearing between four and seven, if the child has learned to read, this result may occasionally be prevented by the exercise of great care and vigilance. Deafness coming on after the age of seven rarely causes mutism, although many exceptions to this rule are on record.

Politzer thus classifies the causes of acquired deaf-mutism—(1) Cerebro-spinal meningitis, meningitis and hydrocephalus. (2) Acute infectious diseases, *e.g.*

¹ *Op. cit.* 866.

typhoid, scarlatina, diphtheria, and measles. (3) Primary ear disease. To these hereditary syphilis may be added.¹

Deaf mutes are not by any means always incapable of perceiving sounds. Hartmann² estimates that out of every hundred, 60·2 are absolutely incapable of hearing, 24·3 are able to perceive loud sounds, while 15·5 can hear vowels and words, which must, of course, be shouted into the ear.

The diagnosis in congenital cases, or in those in which the patient has become quite deaf during the first months of life, is easily made after the age of twelve months. Before that period nothing can be determined with certainty, for some infants who afterwards hear well are remarkably slow to react to sound.³

In conducting the examination of the child certain precautions are necessary. It does not much matter what sound be used as a test, but it is of the utmost importance that it should be produced behind the patient; and, moreover, that it be not of such a kind as to cause vibrations appreciable by the sensory nerves, neither must the shadow of the observer fall across the patient's field of vision, and so attract his attention.

The most convenient test is a whistle blown just behind the child, care being taken that the breath does not fall upon the head or face. If the sound be perceived, the head and eyes will be rotated towards it; but if no notice be taken of the sound, it may be concluded that the hearing power is quite lost. The vibrating tuning-fork, when applied to the forehead of a young child, if heard, often causes it to smile or express other signs of pleasure; but this is by no means an invariable rule.

According to Politzer,⁴ complete congenital deafness

¹ Dalby, *Diseases of the Ear*, p. 201. ² *Deaf-Mutism*, translated by Cassels.

³ Politzer, *Op. cit.*

⁴ *Op. cit.*

is sometimes recovered from to some extent as the child grows up, while total deafness resulting from disease after birth is invariably persistent.

In cases where there is great, but not absolute, loss of hearing, prognosis and treatment alike depend upon those rules which have been laid down in the earlier chapters of this work. If a child becomes deaf, it is of the utmost importance (provided any hearing power be left) to impress upon parents or guardians the necessity of conversing with the patient daily, either by speaking loudly or by means of a conversation tube. Urbantschitsch¹ is convinced that in some deaf mutes the use of the constant current produced improvement to the extent of enabling patients to hear vowel sounds which were before inaudible. When it has been decided that a child is incapable of acquiring speech by means of the sense of hearing, it should, if possible, be instructed in articulate speech by means of the so-called German method. This consists in teaching the deaf mute how (1) to produce words himself, and (2) to interpret into words the motions of a speaker's lips. It would occupy too much space to describe the methods by which these results are achieved, and those who desire fuller information I would refer to the excellent monograph of Hartmann.² Before concluding the subject, it may be well to give the experience of that author as to what may be achieved by the German method :—

‘Taking into consideration the present condition of deaf and dumb instruction, we may say that about a third of all the deaf mutes can be trained to such an extent that they can converse with everybody although their speech has a peculiar character, sometimes more and sometimes less pronounced, in consequence of the

¹ *Lehrbuch*, p. 527.

² *Loc. cit.* p. 167.

articulation of the vowels not being quite perfect, the different sounds not being fluently combined, and the accentuation being defective. In the next third, the above defects are somewhat more marked, their speech being understood by those with whom they generally converse, by their relations, or by such as are in the habit of conversing with deaf mutes, while they are only partially understood by strangers, so that in order to make themselves understood they have to resort to the language of signs. In the last third, speech is so unintelligible that the deaf mutes make no use of it; the consequence is, that it is lost again, and that they return to the sign language. It is especially the stupid deaf mutes who belong to this class. This proportion varies with the training the deaf mutes have received; it will be more unfavourable in institutions where the duration of the instruction is short, and in those in which a great number of pupils have to be instructed by one teacher.'

Education, according to the German system, should begin at the age of seven and extend over a period of years. It is strange that this method of instruction—so long used on the Continent—should in many parts of Great Britain be only available for the wealthy who can afford to send their children to suitable institutions.

Education in lip reading is also likely to prove of use to adults who have become totally deaf, and in such cases a few months' training may be quite sufficient.

CHAPTER XIII.

DISTURBANCE OF THE NERVOUS SYSTEM RESULTING FROM EAR DISEASE.

BEFORE beginning to discuss the effects of ear disease upon the nervous system, it is necessary to glance at the nerve supply of the organ of hearing.

From the meatus and outer layer of the tympanic membrane sensory impressions are conducted to the brain by means of the inferior maxillary division of the fifth nerve. The auricular branch of the vagus also, as we know, ramifies in the external meatus. Within the tympanum is situated the plexus, composed of fibrils from the glosso-pharyngeal, sympathetic, and fifth nerves, while the chorda tympani passes through the drum cavity, where it is almost unprotected.

Let us now proceed to the consideration of such nervous phenomena as may owe their origin to ear disease :—

Anomalies of Taste in Ear Disease.

It is now admitted by most physiologists that the chorda tympani is more or less intimately concerned with the sense of taste in the anterior part of the tongue. From the exposed situation of the nerve in the tympanum, it is, as pointed out by Urbantschitsch,¹ apt to suffer in the course of chronic suppuration of the middle ear. This author found impaired taste in

¹ *Lehrbuch*, p. 413.

a considerable number of cases of this affection. It is also obvious that operations in the neighbourhood of the nerve may cause either temporary or permanent interference with its function. Thus Oscar Wolf¹ relates a case where, in cutting the posterior fold of the membrane, he accidentally injured the chorda tympani, producing not only loss of taste, but also diminished sensibility in the corresponding side of the tongue.

The following² is a brief record of an instance which occurred in my own practice. The patient had a large polypus—with copious otorrhea—in the left ear. On the right side, the greater part of the tympanic membrane had been destroyed by disease, except at its upper margin, and growing from the anterior portion of this was a small polypus, which was removed by means of a wire snare. On asking the patient whether he had experienced any pain, a negative reply was received, but he stated that he had felt, for a moment, as if a wire were being put round the tip of his tongue. On the next day the sense of taste was tested with acid, sweet, salt, and bitter substances, and found deficient in the left anterior part of the tongue, and almost absent in the right,—that is to say, the chorda tympani was involved in the suppurative process on the left side, and was paralysed by the operation on the right. Direct injury to the trunk of the nerve, such as occurred in this case and those recorded by Wolf and Moos,³ seem to produce no more serious results than impairment of taste,—a want which, if unilateral and confined to the distribution of the chorda tympani, is quite endurable, and besides, the paresis is not necessarily persistent.

¹ *Zeitschrift für Ohrenheilkunde*, ix.

² For further particulars, see *Edinburgh Medical Journal*, 1881.

³ *Zeitschrift für Ohrenheilkunde*, viii.

Epilepsy.

A sufficient number of cases have been recorded to demonstrate a causal relation between ear disease and epilepsy. The latter has been traced to the presence of foreign bodies in the ear, and to suppuration of the tympanum. It remains to determine, if possible, the *modus operandi* of the local condition; and, in attempting to do so, I shall but recapitulate the views expressed in my previous papers.¹ All writers on medicine acknowledge peripheral irritation of sensory nerves as a possible starting-point of epileptic attacks; and, in the ear, the anatomical relation of parts is such that a single lesion may stimulate a number of sensory nerves at one and the same time. Taking, as an example, the presence of a foreign body in the meatus, it is obvious that by direct contact it is liable to irritate those branches of the fifth and pneumogastric which ramify on the walls of the canal. A certain amount of pressure may also be exerted upon the drum membrane, and thus communicated through the chain of ossicles to the labyrinthine fluid, producing stimulation of the auditory nerve, including that portion which supplies the semicircular canals. But numerous cases have occurred where, owing to improper attempts at removal, a foreign body has been forced through the drum membrane into the cavity of the tympanum; and, when this has happened, the offending substance may press on the tympanic plexus, made up as it is of fibrils from the glosso-pharyngeal, sympathetic, and fifth.

In chronic suppuration of the middle ear, too, there

¹ 'Epilepsy, Vertigo, and Ear Disease,' by P. M'Bride and A. James, *Edinburgh Medical Journal*, 1880; and 'The Physiology of Auditory Vertigo and some other Neuroses produced by Ear Disease,' *British Medical Journal*, 1882.

is irritation of the tympanic plexus, while the sensory nerves of the meatus may be stimulated by constant contact with an acrid discharge, which not unfrequently produces a troublesome eczema. If, in addition to the chronic inflammation, there be present a polypus, a further possible excitant of reflex epilepsy is added.

Although no positive physiological experiments have hitherto been made in this direction, yet it seems reasonable to conclude that reflex phenomena will be more likely to occur when a stimulus is applied to two or more afferent nerves, than if its action be confined to one. So far, the ear has been considered as a favourable starting-point for reflex phenomena, on account of its great and varied nerve supply.

Another reason, however, yet remains. Rutherford and Hallensten both found that in stimulating sensory nerves the reflex results are more marked the nearer to the centre the irritation is applied. In other words, the less distance an afferent impulse has to travel, the greater will be its effect. All the nerves supplying the ear are, as has been said, cranial, and their peripheral endings are in no case separated by any great length of tissue from the brain.

The case which formed the basis of the paper,¹ before referred to, is so interesting, as showing the transition from auditory vertigo to epilepsy, that I cannot refrain from reproducing it here at some length.

The patient when first examined was twenty-seven years of age. Three years before he was suddenly deprived of consciousness, and on recovering found his face cut. On the afternoon of the same day a second fit occurred, which lasted fifteen minutes, and was attended by convulsive movements of the arms. After this he suffered from epileptic attacks, at intervals

¹ 'Epilepsy, Vertigo, and Ear Disease.'

varying from a fortnight to three months. The patient related that the true fits (*haut mal*) were preceded by a pain over the eye and a 'buzzing in the head.' About a week after the first seizure, the first attack of 'dizziness'—which seems to have been a form of *petit mal*—occurred, and such attacks were afterwards frequent.

The patient volunteered the statement, that when he was any length of time (a week or so) without 'dizziness' he was sure to have a fit. On further questioning, it was elicited that by the term 'dizziness' the patient meant one of two conditions, viz. (1) an attack of vertigo without loss of consciousness, (2) a form of *petit mal*, during which he muttered incoherently, but could not understand what was said. From his applying the same name to both, it was evident that he considered the *petit mal* as merely an aggravation of the simple giddiness. The latter presented all the characters of auditory vertigo (apparent movement of surrounding objects in a uniform direction, etc.). The right ear contained a polypus which, when removed, allowed a large perforation in the tympanic membrane to be seen. The lining membrane of the drum cavity was at first much swollen and granular, but under appropriate treatment became paler and more healthy-looking. Still the suppuration from its surface could never be quite checked. The vertigo and epilepsy were alike benefited by the use of bromide of potassium in large doses. While the ear disease, *i.e.* the chronic suppuration of the tympanic lining membrane, was never quite cured, yet at times (when the patient attended to the prescribed treatment) the secretion of pus and redness were reduced to a minimum. One curious fact in connection with the improvement in the ear was that while the patient was at first morbidly irritable,

peevish, and very sensitive to pain, he was, while the mucous lining of the tympanum was in a comparatively healthy condition (of a pale rose colour, and not granular), sensible and intelligent. At his last visit, however, he again looked stupid and nervous, so much so that he was suspected of being drunk. The patient's statement, however, and the absence of any alcoholic odour, negatived this view, and an examination of the ear showed the lining membrane of the tympanum to be again granular and secreting pus freely.

Our reasons for concluding that the giddiness was auditory were—

(1) The fact that surrounding objects always seemed to the patient to move in the same direction, *i.e.* from left to right.

(2) In walking, the patient staggered towards the affected side, and when sitting still the head often fell over in the same direction.

Now, it is obvious that the last and most important link in the chain of evidence connecting the epilepsy in this case with the ear lesion is wanting. The nervous phenomena were not cured, but neither was the ear disease. Yet it seemed to Dr. James and myself that in the following points we had strong data for believing that between the two conditions existed the relation of cause and effect.

(a) The patient lived a sober, well-conducted life, his family history was good, and the first fit did not occur until the age of twenty-four—a late period for the appearance of idiopathic epilepsy.

(b) The fact that the patient suffered constantly from vertigo, with occasional exacerbations,—symptoms undoubtedly auditory,—and that, by almost imperceptible gradations, this giddiness merged into the attacks of *petit mal*, render the truth of our theory probable.

If we, moreover, remember that, according to the patient's statements, repeated attacks of vertigo warded off the fits, probability becomes well-nigh certainty.

(c) Bromide of potassium relieved alike the vertigo and the epilepsy.

We also found that rapid rotation in rabbits and guinea pigs produce epileptiform manifestations, together with vertiginous phenomena; but for the arguments, in favour of these phenomena being due solely to irritation of the semicircular canals, I must refer the reader to the original paper.¹

Various subjective Symptoms due to Ear Disease.

Cases have been recorded by Köppe² in Germany, and by Browne³ in England, in which mental disturbance, associated with auditory hallucinations, seemed clearly traceable to ear disease, and were cured by local treatment of the part. Less marked phenomena, such as loss of memory and morbid irritability, are described by Von Tröltsch as of comparatively common occurrence in chronic non-suppurative inflammation of the middle ear.

I was somewhat sceptical as to the occurrence of marked mental anomalies depending solely upon ear disease, until I met with a case which left little room for doubt. An elderly woman suffered much from tinnitus, was very deaf, and, moreover, had become childish and forgetful. The case was a simple one (chronic non-suppurative inflammation of the middle ear not far advanced). Local measures relieved all the

¹ Compare also Ormerod on 'Epilepsy in its relation to Ear Disease,' *Brain*, part xxi.

² *Archiv für Ohrenheilkunde*, ix.

³ *Brit. Med. Journal*, 1882.

symptoms, and very distinctly improved her mental power.

A curious symptom, difficult to portray, yet to those who are acquainted with German, well described by the term 'Eingenommenheit des Kopfes,' is often met with. The patient feels as if the brain were too large for its containing cavity, and is also usually troubled by tinnitus. The former phenomenon—I incline to believe—is due to increased tension of the intra-labyrinthine fluid; but the difficulty, in this hypothesis, is, that the symptom in question is often found unassociated with vertigo. It is known that the labyrinthine communicate directly with the cerebro-spinal fluids. It seems possible that, in those patients in whom increased pressure inwards of the stapes causes this symptom, without first producing giddiness, the channels of communication may be wider than usual, and, in this way, the plus of tension is felt more within the cranium and less in the semicircular canals. It may be, however, that the phenomenon is purely reflex; and this view again is supported by the fact that this symptom, when occurring from incurable ear disease, is sometimes amenable to treatment by means of the bromides. Indeed, I may here state my conviction, that when any of the various nervous phenomena attributable to pathological conditions of the organ of hearing occur in a case which is not amenable to local treatment, large doses of the bromides should be prescribed, with a view to palliating the discomfort.

Ear Cough and Ear Sneezing.

Ear disease may, as is now universally accepted, produce spasmodic cough; and recently Dr. Russell of Birmingham has called attention to the fact that the

same cause may sometimes give rise to repeated fits of sneezing.

Dr. Woakes¹ has explained these symptoms on a theory which, though ingenious, does not rest upon that sound and indisputable physiological basis which should, in my opinion, form the groundwork of every hypothesis. A more satisfactory explanation is, I believe, as follows:—

The external meatus and outer layer of the drum membrane form an area which is supplied both by the fifth nerve and a branch of the pneumogastric. A stimulus applied to this surface, if it affect only or chiefly the vagus, will be carried to the centre, corresponding to the termination of that nerve, and will thus act upon the respiratory muscles, producing cough. If, however, both the fifth and pneumogastric be stimulated at the same time, it is obvious that an impulse conveyed to the central termination of the former—from which it is transferred to the cerebral area, corresponding to those branches which are distributed to the nares—may so modify the expiratory act, that it becomes converted into a sneeze.

Auditory Vertigo.

By far the most common, and therefore the most important, nervous symptom of ear disease is vertigo, and to this subject we must devote the space which its importance deserves.

The physiology of auditory vertigo.—The elementary facts of nerve physiology teach that in a centre—be it brain or spinal cord—impressions conducted thither tend to radiate. In the common experiment of tickling the sole of the foot, the impression conveyed by the sensory nerve is radiated, first to the motor nerves

¹ *Deafness, Giddiness, and Noises in the Head*, chapter v.

of the leg, and then, if the stimulus be continued, to all the motor nerves of the body. It is urged by Dr. Woakes¹ that 'it is not the function of a sensory nerve when exhibiting reflex phenomena to induce pain, but muscular contraction.' That is to say, the radiation from the central ending of one sensory branch to a central area, corresponding to the distribution of another set of fibres, with resulting pain in the area so supplied, is denied. We have only to turn to the pain referred to the knee in cases of hip-joint disease, and to that caused in the ear by the presence of a carious tooth, for a refutation as complete as it is conclusive. I am aware that Dr. Woakes would refer the latter phenomenon to inflammatory changes produced by reflex stimulation of the trophic nerve supply of the ear. I believe, however, that every experienced aurist will agree in the statement, that in most cases of aural neuralgia due to carious teeth, no inflammatory changes can be discovered in the meatus or drum membrane. Indeed, it is the very absence of any such change, to account for the pain, that makes him able to say to a patient, so affected, that extraction of the offending tooth will afford relief.

Granting, then, that stimulation of a sensory nerve may cause overflow of nerve energy from its central termination, the explanation of the phenomena of an aggravated attack of auditory vertigo is easy. A stimulus is conveyed by the nerves of the semicircular canals to their central termination, and thus vertigo is produced. It is now conclusively proved, both by physiological experiment² upon animals and by clinical³

¹ *Deafness, Giddiness, etc.*, p. 79.

² Comp. 'Beitrag zur Phys. der haltkreisformigen Kanäle,' by Spamer, Pflüger's *Archiv* xxi., one of the most recent and elaborate works on the subject.

³ For full discussion of this point, see 'Etiology of Vertigo,' by the author, *Medical Times and Gazette*, 1881.

observation, that lesion of the canals causes vertiginous phenomena. The latter must be due to stimulation of an intra-cranial area, corresponding to the central termination of the branches of the auditory nerve which supply the ampullae, and this fact justifies us in speaking of a vertiginous centre. As we shall see farther on, a severe attack is usually followed by vomiting and cardiac depression, while it may even result in syncope. The vomiting is probably caused by a radiation of the original stimulus to the vomiting centre, and the symptoms pointing to failure of the heart's action indicate overflow of nerve force to the cardiac inhibitory area.

Symptoms.—Auditory vertigo is characterized by a sensation of motion referred by the patient either to himself (a feeling of forced movement) or to surrounding objects, which seem to revolve in certain definite planes. The attacks of giddiness are often paroxysmal, but sometimes a more or less constant vertigo is present, subject to exacerbations of a paroxysmal character. Clinically several types exist.

(1.) There is the well-known group of symptoms described by Menière as occurring in primary disease of the labyrinth, although, as we shall see later, they are also met with in disease of the middle ear. The patient is suddenly and often without warning attacked by severe tinnitus and intense vertigo. Indeed, the latter is usually so severe in this group of cases, that no analysis of the symptoms can be attempted in the early stage. The sufferer falls usually towards the side corresponding to the ear which is the cause of the phenomena. The vertigo then abates somewhat, or seems to be less severe owing to the enforced recumbent attitude, and surrounding objects appear to move in some definite direction around the patient.

Nausea and faintness are complained of, a cold perspiration breaks out over the body, and violent vomiting supervenes, while occasionally—although only in aggravated cases—the attack is the cause of loss of consciousness. After a variable interval the symptoms pass off and the patient is restored to his usual state of health. If the symptoms be due to primary disease of the labyrinth, total deafness on one side usually remains, while if middle ear mischief be the exciting cause, the hearing power is often not appreciably altered by the attack.

(2.) A more common variety than the preceding is characterized by a milder form of vertigo, which, however, is more or less constant, and sometimes subject to temporary exacerbations. In these cases the patient tends to stagger to one side in walking, and questioning will generally elicit the fact that if the eyes be fixed on any object it seems to revolve always in a definite plane.

(3.) In a still less marked form of auditory vertigo, giddiness is only caused by such acts as turning round suddenly, looking down or up quickly, stooping, and the like. This probably denotes that owing to the ear lesion the nerves of the semicircular canals are in a state of hyperæsthesia.

The following case is typical in so far as it presents all the various types of auditory vertigo occurring in the same patient :—

W. H., æt. 58, complained of giddiness and staggering. He is a blacksmith by trade, and exposed to sudden changes of temperature; and to this he attributes, in a great measure, his illness. For five years his hearing has been getting gradually worse.

Before the patient applied for advice he had two very severe paroxysms of vertigo with an interval of

two days between them. What occurred on these occasions seems to have been, that the patient felt intensely giddy, heard noises in his head, and lost consciousness. This happened for the first time on a public thoroughfare, and when he recovered his senses he found himself seated, and being attended to by the bystanders. He then felt sick, and everything about him seemed to turn (direction not observed). He staggered home, and when he got there vomited and fell asleep. On awakening, he felt better, and next day went to work feeling well. On the day following, however, he had a repetition of the attack. Since then the patient has been troubled with constant giddiness and staggering towards the left. A mixture of iodide and bromide of potassium had little or no effect on the symptoms. The giddiness and staggering excepted, he seemed in good health.

Examination of the ears gave the following results:— Watch (normally heard at 30 inches) was not heard in contact with either auricle. Conversation was, however, fairly understood, and the tuning-fork well heard in both ears by bone conduction.

The right membrane was opaque, with vascular injection along the handle of the malleus, and anteriorly above there was an atrophic patch. The left membrane was indrawn, the anterior and posterior folds being very prominent. Politzer's inflation at first succeeded in forcing air into the left tympanum only. After this inspection revealed the corresponding membrane to be flattened out, the folds having all but disappeared. Air could only be driven into the right middle ear through the Eustachian catheter, and auscultation during the process yielded a distant gurgle, indicating an accumulation of mucus in the pharyngeal orifice of the right Eustachian tube.

On the first attempt to inflate the tympana by Politzer's method, a very extraordinary effect was produced. As stated, air only entered the left middle ear; but whereas, before the operation, the patient had the greatest difficulty in standing and walking, even with assistance, after the inflation he immediately declared himself greatly relieved, and was able to walk about alone and unsupported. The subsequent treatment consisted in astringent applications to the throat and naso-pharynx (which were in a catarrhal state), inflation of iodised steam by Valsalva's method, and the occasional use of the air-bag and Eustachian catheter. The result of this treatment was, that in a week or two the only symptom of vertigo remaining was a slight feeling of giddiness produced by looking down suddenly. The hearing also improved considerably, while the tinnitus, although not cured, was greatly relieved.

The explanation of the various phenomena presented by this case is probably as follows. While the irritation of the semicircular canals was at its height, a strong stimulus was conveyed to the vertiginous area; but immediately, owing to its intensity, overflowed and reached, finally, the centre for cardiac inhibition, causing syncope. As its force diminished, the area of overflow became circumscribed, permitting a return to consciousness, but causing vomiting and vertigo. The last-named symptom, capable of being produced by a comparatively small amount of stimulus applied to the canals, remained persistent. As to the chain of events which in this and similar cases led to irritation of the ampullae, we shall give an explanation in a later paragraph. The paroxysmal character of the severe attacks will also be again referred to.

Ear lesions which produce vertigo.—It may be

generally stated that any ear affection may produce giddiness. Obviously, primary disease of the semicircular canals (hæmorrhage or serous effusion) invariably produces vertigo, and very generally gives rise to an aggravated attack—comprising giddiness, tinnitus, nausea, vomiting and faintness, usually stopping short of actual syncope.

Two years ago I¹ ventured to express the view, that auditory vertigo is most common as a result of middle ear disease, and this opinion has been confirmed by an extended experience. While it is true that primary disease of the labyrinth is usually accompanied by vertigo, and that chronic middle ear disease only sometimes leads to the same result, it must be remembered that cases of primary labyrinthine disease (including cochlitis alone, which causes no giddiness) are to be counted by units, while those of tympanic inflammation occur in hundreds. It is therefore not surprising that, on the whole, more cases of vertigo, due to the latter, are met with. It is for this reason perfectly unjustifiable to consider every case of deafness and giddiness as due to hæmorrhage into the semicircular canals, and therefore incurable.

Giddiness in tympanic disease is produced in various ways. If the middle ear be inflamed, exudation may be poured into the drum cavity, and press upon the fenestræ, increased tension of the perilymph being thus caused. Moreover, the anastomosis between the circulation of the tympanum and that of the labyrinth, pointed out by Politzer,² must also be regarded as a secondary factor, tending towards the same result. In chronic non-suppurative inflammation, however, I believe the most common cause of pressure on the

¹ 'Auditory Vertigo,' *Edin. Med. Journ.* 1881.

² *Lehrbuch der Ohrenheilkunde*, vol. i. 52.

fenestræ to be either obstruction of the Eustachian tube or fixation of the ossicles.

In the former case, as we know, the air within the tympanum is rarefied, and the relatively increased pressure of the external atmosphere forces the membrane inwards, and with it the chain of ossicles. The stapes is thus pressed into the fenestra ovalis, causing increased tension of the labyrinthine fluids.

If the ossicles (especially the stapes) be immovably fixed, then the perilymph is met by a resistant surface, where, normally, there should be a yielding membrane, and a similar result is arrived at under certain conditions, *e.g.* dilatation of the blood-vessels of the internal ear, and possibly increased secretion of endo- or perilymph.

The next question to be determined is the cause of the occurrence of distinct paroxysms of vertigo, in cases where the symptom is due to what, at first sight, seems an unchanging pathological condition. It is true that in many of these cases the inward pressure is the same all through, but the condition of the labyrinthine circulation, and possibly the quantity of the contained fluid, may vary. Moreover, even in the same individual the stability of the nerve centres may alter. It would, of course, be easy to account for the phenomenon by the doctrine of summation of stimuli; but this should, I think, be reserved as a *dernier ressort* in a practical treatise.

Just as indrawing of the drum membrane, by excess of atmospheric pressure, may cause giddiness, so may the presence of a foreign body—*e.g.* cerumen, the products of inflammation, etc.—tend to the same result. It has long been a doubtful question as to why syringing the ear with cold water is so much more apt to produce unpleasant symptoms than if warm

fluid be used. An explanation suggests itself in the fact that warm water driven into the ear will only produce the mechanical effect of a foreign body pressing upon the drum membrane. A cold injection will, however, produce the same result, plus stimulation of the branches of the trigeminus and vagus which ramify in the meatus—a summation of stimuli in the true sense of the term.

Differential diagnosis of auditory vertigo.—The giddiness caused by ear disease is usually a true vertigo—that is to say, a sensation of motion is experienced, referred by the patient either to himself or to surrounding objects. This fact alone distinguishes it from swimming in the head, so often described as giddiness, but which, on being analysed, is found to be more of the nature of momentary confusion, and is common as a premonitory symptom of syncope. *Petit mal*, in all likelihood, rarely gives rise to true vertigo, although the victims of this disease frequently use the term giddiness in describing their attacks. Glancing at those conditions, which may, by producing analogous symptoms, cause aural vertigo to be simulated, we find—

(1.) *Intra-cranial lesions.*—Cerebellar tumours may give rise both to forced movements and to subjective sensations of motion referred to surrounding objects. If it be remembered that tumours in this situation are very liable to press upon the auditory nerve, and, moreover, that Schwertze has observed that pressure on one auditory nerve may produce bilateral deafness,¹ it will be obvious how difficult it is to arrive at a differential diagnosis. If the history be one of gradually increasing deafness and vertigo, and if the tuning-fork test point to nerve deafness, the case may be one

¹ *Patholog. Anatomie des Ohres*, p. 131.

either of cerebellar tumour or of chronic middle ear disease, which has gone on to secondary labyrinthine affection. In such a case the diagnosis must depend upon the presence or absence of optic neuritis; and if examination of the eye give negative results, it may only be possible to arrive at a correct diagnosis by watching the progress of the disease. The difficulty in distinguishing between these two conditions is not surprising. In speaking of the physiology of auditory vertigo, I purposely avoided alluding to the anatomical seat of what I ventured to term the vertiginous centre; but it may here be observed that it is not at all improbable that those fibrils of the auditory nerve which supply the semicircular canals come from the cerebellum, in which case auditory vertigo is indeed a reflex cerebellar phenomenon.¹

(2.) *Stomach vertigo*. — According to the theory advanced, in speaking of the physiology of auditory vertigo, we should expect that while in the latter giddiness is the first and may be the only symptom, the same phenomenon would, if due to irritation of the stomach, be preceded by nausea or vomiting. When dyspepsia causes disturbance of equilibration, the afferent impulse passes through the sensory nerves of the stomach to the pneumogastric centre; and the latter, which is in all probability connected with the act of vomiting, is stimulated before radiation extends to the vertiginous area. The following case is an example. The patient, a medical gentleman, is subject to gout, dyspepsia, and vertigo. He is deaf from proliferous catarrh. The giddiness is always preceded by nausea or vomiting, and yields to alkalies and bitters. The diagnosis seemed to me to be vertigo or stomacho

¹ Compare Stefani und Weis, quoted by Spamer, Pflüger's *Archiv* xxi., and Gellé, *Gaz. Méd. de Paris*, No. 21, 1880.

læso, possibly aggravated by the ear mischief. Had the giddiness been followed by nausea or vomiting, this would have pointed to auditory vertigo.

Dr. Woakes¹ has advanced quite a different explanation of the occurrence of stomach vertigo. He believes that irritating ingesta convey a shock to the afferent fibres of the pneumogastric, and that this is then passed on to the inferior cervical ganglion of the sympathetic, which gives vaso-motor fibres to the vertebral artery, a terminal branch of which—the internal auditory—supplies the semicircular canals. He then assumes that such a stimulus will cause temporary vaso-motor paralysis, and give rise to vascular dilatation in the internal ear, with increased tension of the endolymph. We know so little of vaso-dilator nerves that it is impossible to form a sound hypothesis upon their action. Of vaso-constrictors we have more knowledge, but certainly not enough to permit the statement, that the shock, produced by undigested food, and conducted by a route so circuitous as that suggested, is capable of producing a disturbance of circulation in an area so limited as the labyrinth. The explanation of the connection between stomachic and labyrinthine vertigo sketched in this chapter, and more fully discussed in various papers,² is at least based upon physiological laws and supported by analogy—two essentials which should form the basis of every tenable hypothesis.

(3.) *Ocular vertigo*.—Ocular vertigo is often well marked in paralysis of the third and sixth nerves, and also in nystagmus. The etiology of the giddiness is probably as follows. In attempting to correct the defective position of the eyeballs an excessive amount of

¹ *Loc. cit.*

² 'Physiology of Auditory Vertigo,' etc., *Brit. Med. Jour.*, Dec. 1882; 'Etiology of Vertigo,' *Med. Times and Gaz.*, vol. i. 1881.

nerve force is generated and thrown back upon the vertiginous centre, which experiments upon the lower animals and clinical observations have shown to be intimately connected with the oculo-motor centre. Thus Cyon¹ found that section of the semicircular canals produced oscillation of the eyeballs; and many other corroborative facts might be stated, as, for example, the occurrence of nystagmus² from ear disease. A medical gentleman of my acquaintance, who suffered from squint, could correct it at will, but in doing so experienced both nausea and vertigo.

Before concluding the subject of the differential diagnosis of auditory vertigo, it is right to draw attention to the fact that here, as in loco-motor ataxia, closing the eyes makes equilibration more difficult (Politzer³).

Prognosis.—This must of course depend upon that of the ear lesion which is the cause of the symptom. Obviously the probability of the vertigo continuing is greater in proportion as the exciting cause is likely to remain constant. In primary disease of the labyrinth, although deafness generally persists, giddiness usually passes off. Again, if the ear lesion be curable, the symptoms can be relieved; but in those cases where more or less constant irritation (insufficient to produce loss of function) of the auditory nerve is caused by changes in the fenestræ, due to fibroid or osseous deposits in the tympanum, little but palliation can be expected.

Predisposition to auditory vertigo.—It is a well-known fact that, except when the labyrinth or auditory nerve is actually the seat of pathological lesions, auditory vertigo is rare in children. Even among adults a lesion which will be followed by

¹ *Recherches Experimentales sur les fonctions des canaux semicirculaires.*

² *Archiv für Ohrenheilkunde*, xiii. 68, and case recorded by Hughlings Jackson, *Transactions of the Ophthal. Soc.* 1883.

³ *Lehrbuch*, vol. ii. 801.

giddiness in one patient produces no such symptom in another. The degree of stability of the nerve centres probably exercises more influence in this direction than anything else in grown-up persons; but the difficulty in accepting this explanation as complete lies in the comparative immunity of childhood, during which period there is a predisposition to convulsive seizures. It would, however, serve little purpose here to enter into abstruse attempts at explaining the apparent discrepancy—a problem which with our present knowledge cannot be solved.

Treatment.—The treatment of auditory vertigo should consist in removing the cause, or in other words, curing the ear disease. When this is impossible, some palliative must be resorted to. Bromide of potassium given in large doses, and on the same principle as in epilepsy, will, I believe, be found most efficacious. Quinine, as recommended by Charcot, must be used with discrimination and care. If it be true¹ that this drug causes congestion of the auditory apparatus, it is on this account unsafe, unless indeed deafness be bilateral and complete, fortunately not a very common condition. Of other drugs, such as gelseminum,² etc., which have been used, I have had no experience, as the bromides have usually proved efficacious.

It is obvious that the general health, and especially the tone of the nervous system, must be studied, while the treatment necessary during the paroxysm must be conducted on general medical principles, bearing in mind what has already been said, particularly as to primary disease of the labyrinth.

¹ We shall see in the next chapter that it is much more probable that quinine causes contraction of the cerebral vessels; but so long as any uncertainty exists as to its action, this drug should be administered with great care in ear disease.

² *Handbook of Therapeutics*, Ringer.

CHAPTER XIV.

TINNITUS AURIUM.¹

TINNITUS may arise under conditions so numerous and varied, that to treat the subject systematically, and at the same time fully, is a task of extreme difficulty.

There is a form of auditory hallucination which is by many authors classed as tinnitus. I allude to the hearing of various melodies, or of animal cries or even human voices, which have no objective existence. Brunner² and Hartmann,³ however, regard these phenomena as psychic in their nature, and due to irritation of the higher centres. That such is the case is evident; but whether this irritation may not be produced by stimulation of the peripheral extremity of a sensory nerve—more especially the auditory—we must leave an open question in the present state of our knowledge.

While not committed to any hypothesis as to the production of this rare form of tinnitus, let us turn to a consideration of less obscure varieties.

The sounds described by sufferers vary greatly in character. To quote from Sir William Wilde,⁴ ‘Persons from the country or rural districts draw their similitudes from the objects and noises by which they have been surrounded, as the falling and rushing of water,

¹ This chapter has been re-written from a paper on ‘Tinnitus Aurium,’ which was read by the author at the Medico-Chirurgical Society of Edinburgh, and subsequently appeared in the *Med. Times and Gazette* (1882).

² *Archives of Otology*, vol. ix.

³ *Die Krankheiten des Ohres*, p. 47.

⁴ *Aural Surgery*, p. 83.

the singing of birds, the buzzing of bees, and the waving or rustling of trees ; while, on the other hand, persons living in town, or in the vicinity of machinery or manufactures, say that they hear the rolling of carriages, hammering, and the various noises caused by steam-engines. Servants almost invariably add to their other complaints that they suffer from the ringing of bells in their ears ; while in this country, old women, much given to tea-drinking, sum up the category of their ailments by saying that all the kettles in Ireland are boiling in their ears. The tidal sound, or that which we can produce by holding a conch shell to the ear, is, however, what is most frequently complained of.'

Perhaps the division proposed by Dr. Woakes¹ into tidal, rushing, pulsating, and bubbling, is as accurate and comprehensive a classification as the subject admits.

Brunner² has noticed a clear, ringing note as the result of violent stimulation of the auditory nerve, either by loud sound or electricity. In one patient he could produce this subjective phenomenon by touching a granulation which grew from the promontory in which is contained the first turn of the cochlea. He therefore suggests that the auditory nerve may react as a whole, producing the sensation of a high metallic sound, just as in the case of the optic nerve electric stimulation pressure and section are known to produce sensations of light. In cases of ear disease also, when the stapes is exposed to view, touching it with a probe is followed by violent ringing in the ear.

The opinion is still held by many, that the most common cause of tinnitus aurium is to be sought in hyperæsthesia of the auditory nerve. Now, while readily admitting that this may be a predisposing element, it is difficult to believe that it is ever an

¹ *Deafness, Giddiness, etc.*, chap. vii.

² *Op. cit.*

exciting cause. Hyperæsthesia of the nerves of hearing no doubt occurs, but probably seldom without the whole nervous system being similarly affected. Where it does exist, it is likely that the arterial or venous currents, either in the labyrinthine or adjacent vessels, will be perceived by the over-sensitive nerve. Hyperæsthesia means that stimuli are readily conducted by the nerves, and widely diffused in the ganglia; but it does not imply that the nerves can convey impressions which have no existence. It is obvious that tinnitus must arise from a stimulus either applied to the auditory nerve or conducted by other channels to its centre. Stimulation of the former is under ordinary circumstances always due to vibration of the fluid contents of the labyrinth. Occasionally pathological conditions exist which cause direct pressure on the nerve trunk, the result of such pressure being probably first stimulation and then paralysis. The auditory centre may also be reached through nerves of common sensation, as in those cases in which subjective auditory phenomena are due to the presence of carious teeth.

Having then arrived at the conclusion that in every case some factor other than hyperæsthesia of the auditory nerve is to be sought, we shall consider possible causes more in detail.

An abnormal condition of the auditory apparatus is probably the commonest cause of tinnitus aurium. Any foreign body in the meatus is liable to produce the symptom in question. The mass may be large or small; it may be composed of wax, epithelium, fungus, or the products of an eczema. In these cases the actual cause of the tinnitus is to be sought in one or more of the following factors. (1) Slight vibrations communicated to the drum membrane by contact with the substance. (2) Pressure on the drum membrane

communicated to the stapes, and producing a change of tension in the labyrinthine fluid. (3) Pressure on the walls of the meatus causing vascular changes, and possibly murmurs, audible to the ear in which they occur.

It is in middle ear disease with imperforate drum membrane that we most frequently meet with tinnitus. In these cases the symptom is usually ascribed to one or more of the following causes. (1) Abnormal conditions of the intrinsic muscles of the tympanum. (2) Vascular changes. (3) Increased intra-labyrinthine tension. (4) The presence of free fluid in the tympanum. Each of these we must now consider separately.

There can be no doubt that in certain cases spasmodic contraction of the intrinsic muscles may be perceived as a sound by the person in whom it occurs. Gottstein¹ describes a case in which tinnitus was present, together with blepharospasm, and where he felt justified in concluding that the former symptom was produced by tetanic contraction of the stapedius. Spasm of the tensor tympani may produce subjective auditory phenomena, partly by causing the sound of muscle contraction, and partly by forcing the stapes inwards and increasing intra-labyrinthine tension. Inflammatory shortening of the tendon—such as may occur in the course of chronic non-suppurative inflammation—must of course also produce the last-named effect. While prepared to admit that a tetanic condition of the middle ear muscles may cause subjective auditory phenomena, I have difficulty in accepting this explanation of cases in which tinnitus lasts for months and years without intermission. It is difficult to understand why the middle

¹ *Archiv für Ohrenheilkunde*, xvi.

ear muscles should become the seat of such a rare condition as permanent spasm, unless, perhaps,—under conditions not yet defined,—their contraction places the ear under the most favourable condition for hearing, just as spasm of the ciliary muscles is a common result of hypermetropia. As to paralysis of the intrinsic muscles of the middle ear,—on which Mr. Field, among others, has laid considerable stress,—it can only be said that its existence has to be proved before we can describe it as a frequent cause of tinnitus.

Vascular changes in the tympanum and labyrinth no doubt constitute a very common cause of noises in the head. Many authors consider that when the vessels of the middle ear are distended, the pulsation of the arteries and the rushing of the venous blood may be perceived as tinnitus. Whether the small vessels of the drum cavity and its membrane ever cause vibrations ample enough to produce audible sounds seems doubtful; but it must be remembered that a small arterial twig passes over the footplate of the stapes, and the pulsations of this vessel may be communicated thus directly to the perilymph. Then, again, recent researches by Politzer have established the existence of an anastomosis between the tympanum and labyrinth, so that changes in the former must to some extent influence the latter.

Increased intra-labyrinthine tension can hardly in itself be a cause of continued tinnitus; for, as Dr. Woakes¹ points out, pressure sufficient to cause mechanical irritation would soon lead to atrophy and disintegration with complete loss of function. It is probable that any change of tension—whether plus or minus—in the fluids of the labyrinth will favour the production of tinnitus, by allowing the vibrations of

¹ *Loc. cit.*

the labyrinthine vessels to be perceived. The latter are not noticed during health, but let any one physical condition be changed—be it in the balance between peri and endolymph, in the calibre of the vessels, or the rapidity of the circulation—and tinnitus will result. For instance, alcohol may produce subjective sensations of sound, by increasing the force of the circulation. Noises in the head frequently precede a fainting fit; while, as we shall see later, the same symptom is produced by drugs which dilate, and by those which probably contract, the vessels of the encephalon. A parallel case is the heart-beat, which is not felt under ordinary conditions, but becomes excessively disagreeable when either abnormally strong or weak.

Dr. Weil¹ has noticed that certain forms of tinnitus can be temporarily cured by blowing upon the walls of the meatus; while Türk effected the same object by pressure on the inferior cervical vertebræ and mastoid process. This result the former ascribes to stimulation of the sympathetic, for during the process (blowing) the pupils dilate; and he very naturally draws the conclusion that those forms of tinnitus which can be thus relieved are due to vascular conditions.

In some cases the nature of the subjective phenomena gives a clue to their etiology. Thus, if a beating or hammering sound, synchronous with the pulse, be heard by the patient, its cause may be sought in arterial pulsation, while many rushing sounds are due to the venous circulation. In Menière's disease, and in primary affection of the cochlea, we may assume that the subjective auditory sensations are in a great measure due to vascular changes in the labyrinth. When fluid is present in the tympanum the patient

¹ *Monatsschrift für Ohrenheilkunde*, 1881.

may experience splashing or bubbling sounds, and even have the sensation of liquid moving in the ear.¹ Some persons have the power of producing a clicking sound in the region of the ear, which is also audible to others. It may even be so loud that it can be heard by the observer at some distance. The sound somewhat resembles that produced by clicking the nails together, and occasionally occurs involuntarily, causing much annoyance. Spasmodic action of the palate muscles, and sometimes of the tensor tympani, are the causes to which this symptom has been ascribed.

It must be obvious, from what has been said, that in many cases the actual cause of tinnitus must remain obscure, although the ear disease upon which it depends is recognised. In most cases, I believe, the immediate cause is to be sought in the circulation of the labyrinth; but owing to our imperfect means of diagnosing exactly the condition of parts within the drum cavity, we must often remain in the dark as to the predisposing element. Each case must be judged on its own merits, and unfortunately empirical methods of treatment must at times be adopted to combat a symptom which has been known to drive strong men to suicide. Occasionally, although seldom, noises in the head are complained of by patients who are the subjects of chronic middle ear suppuration. In those cases the symptom is due to physical conditions, similar to those which have been already described—the most common being pressure against the fenestræ produced by the presence of exudation.

Having discussed the etiology of tinnitus so far as it may arise from local conditions confined to the ear, we must now consider the symptom in question as it may occur from other causes, some of which belong

¹ Burnett *On the Ear*, p. 430.

to the domain of the physician rather than to that of the aurist.

It seems to be the generally accepted opinion of authors, that tinnitus may be due to peripheral stimulation of sensory nerves other than the auditory—or in other words, the result of a radiated impression. There are clinical facts which tend to confirm this view, such as the pain experienced in some cases of asthenopia, in which a transference of impression probably takes place from the optic to the fifth nerve. In megrim we frequently meet with disturbance of vision,—probably due to central causes,—and less frequently deafness and tinnitus aurium,¹ showing that there is a tendency for an impression to be propagated from the auditory centre to that corresponding to the origin of the fifth nerve. Indeed, Poincaré² assumes the existence of such a relation to account for the symptoms of pain manifested by animals when the auditory nerve is directly stimulated. Subjective auditory phenomena are found in some cases to be due to the presence of carious teeth. Wolf observed tinnitus aurium as a result of acute glaucoma, and Weber Liel³ has traced the same symptom to a neurosis of the cervical plexus. Intra-cranial tumours may cause deafness and tinnitus, either by exercising direct pressure upon the trunk of the auditory nerve, or by obstructing the labyrinthine circulation; but disturbance of hearing produced by this cause will be again referred to in the next chapter.

We shall next consider pathological conditions of the vessels in the neighbourhood of the ear as a cause of noises in the head, the sound being in these cases sometimes audible to the observer as well as to

¹ Bristowe, *Practice of Medicine*.

² *Physiologie de Syst. Nerv.*

³ Urbantschitsch *Lehrbuch der Ohrenheilkunde*, p. 486.

the patient. Chimani has recorded a case in which constant and annoying tinnitus was due to a cirroid aneurism of the auricle, and relieved by its cure. Hutchinson has described a case of aneurism of the common carotid which had become cured by coagulation; tinnitus, audible alike to patient and surgeon, lasted for a considerable time afterwards. Aneurismal dilatation of the occipital, temporal, and posterior auricular arteries may also occur. A very interesting case in which the last-named artery was affected, and where severe pulsating tinnitus was one of the most annoying symptoms, was observed by Herzog.¹ The swelling was situated over the mastoid, and yielded on auscultation a bruit corresponding to that described by the patient.

Lebert in his classical papers on intra-cranial aneurism² writes: 'Of the greatest interest are disorders of hearing; but we cannot always ascertain in what proportion they are due to changes in the auditory nerve itself, or its nucleus, and to what extent the small internal auditory artery—which is for the most part hidden from ordinary observation—by becoming obliterated contributes to the result. Tinnitus, impairment of hearing, partial deafness on one side, becoming complete, and at a later stage bilateral, or even bilateral from the beginning, are the symptoms which have been observed. The observations are unfortunately not always complete, *i.e.* deafness and unilateral deafness are not sufficiently differentiated, which is surely an important point. These phenomena are rare when the carotid system is involved. Only once did deafness occur in a case of aneurism of the posterior communicating artery; once there was deafness and tinnitus with aneurism of the anterior cerebral. Where the middle

¹ *Monatsschrift für Ohrenheilkunde*, 1881.

² *Berlin. Klin. Wochenschrift*, 1866, p. 347.

cerebral was involved tinnitus was frequently observed, but without deafness. On the other hand, there was present in no less than six cases of aneurism of the basilar artery, deafness which came on rapidly and was accompanied by tinnitus. As a considerable proportion of these cases only came under observation after an apoplectic seizure had occurred, it is fair to assume that auditory phenomena occur even oftener. Disturbance of hearing may then, under some circumstances, become an important element in the diagnosis of basilar aneurism.'

In an elaborate article on pulsating exophthalmos, Sattler¹ mentions beating and rushing sounds in the head, as a frequent and very troublesome symptom. So loud is the sound at times that patients, without being deaf in the true sense of the word, have difficulty in distinguishing other sounds. Compression of the common carotid generally stops the distressing noise for a time. Usually the murmur can be heard by placing the stethoscope over any part of the side of the head, although it is loudest over the orbit. In these cases of exophthalmos the condition is often due to injury, and after death, aneurism of the ophthalmic artery, aneurism by anastomosis between the carotid artery and cavernous sinus, and thrombosis of the latter have been found. In one case, after an injury, the pulsating exophthalmos only appeared occasionally, the eyeball being perfectly normal in the intervals. Vaso-motor paresis of the orbital vessels was the diagnosis arrived at by a process of exclusion. A very interesting case of tinnitus, audible by means of the stethoscope, and eventually accompanied by exophthalmos, has been recorded by Dr. Poorten.²

¹ *Handbuch der Gesammten Augenheilkunde Gräfe und Sacmisch.*

² *Monatsschrift für Ohrenheilkunde*, 1878, No. 4.

Brandeis¹ observed two patients affected with noises in the head. In one the symptom was due to interference with the circulation through the vertebral artery, caused by cervical spondylitis, and was cured by treatment directed to the last-named condition (viz. wearing a support); while in the second case great relief was obtained by treatment directed towards a goitre which pressed upon the veins of the neck.

Sometimes murmurs may occur in arteries near the ear without organic disease. In 1854, Rayer² called attention to a case of unilateral tinnitus audible to the auscultator, which ceased while pressure was exerted upon the posterior auricular artery, and in which there existed no aneurism or heart disease. In an interesting paper on arterial murmur, Dr. Richardson³ described several cases of bruit in the neighbourhood of the ear, in which tinnitus was a prominent symptom, and yet no aneurism existed. In one patient general treatment effected a complete cure. A similar case was described by Mr. Fitzgerald⁴ at the otological section of the International Congress of 1881. He also mentioned a case of audible tinnitus occurring on one side only in a chlorotic girl. A relaxed condition of the arterial walls, or a watery condition of the blood,—perhaps both together,—might in some cases account for the bruit. It is somewhat more difficult, however, to explain the phenomenon being unilateral. As possible causes, one would naturally think of abnormally distributed vessels, or disproportion between the carotid canal in the temporal bone and the calibre of the artery. A limited vaso-motor change, too, must be considered to be within the bounds of possibility. Whatever be the

¹ *Archives of Otolaryngology*, 1882.

² *Lehrbuch der Ohrenheilkunde Von Tröltsch*.

³ *Medical Times and Gazette*, 1860, p. 442.

⁴ *Transactions*.

explanation, the clinical fact remains, that such unilateral murmurs in the neighbourhood of the ear, giving rise to the most distressing tinnitus, may exist without any organic disease of the vascular system, and disappear under suitable treatment.

Dr. Charles Burnett¹ has described several cases of tinnitus aurium which were accompanied by other evidence of vaso-motor weakness, such as flushing of the face and upper parts of the body. In one patient there was flushing of the side of the face corresponding to the ear in which the subjective phenomenon was most marked.

In some rare cases of heart disease the cardiac murmur is audible to the patient, as observed by Dr. Walshe.²

It has already been suggested that, although in health the labyrinthine circulation is not perceived, yet when the normal physical conditions are in any way changed or modified, subjective sensations of sound are the result. In discussing this aspect of our subject it is necessary to take into consideration—

- (1.) The condition of the blood vessels.
- (2.) The rapidity of the circulation.
- (3.) The quality of the blood.

According to Da Costa,³ cerebral anæmia and hyperæmia are alike liable to cause tinnitus. The same author, in a paper on the nervous symptoms of lithæmia,⁴ alludes to noises in the ears and deafness as occurring occasionally. He has also observed defects of vision in which the ophthalmoscope revealed congestion of the retina. It seems therefore fair to assume, that when auditory phenomena co-exist with this condition, they are also due to hyperæmia of the internal ear.

¹ *Archiv. of Ophthalm. and Otol.*, also *Diseases of the Ear*, p. 391.

² *Diseases of the Heart*, p. 148.

³ *Medical Diagnosis*, 70.

⁴ *American Journal of Medical Sciences*, vol. lxxxii.

Murchison¹ has also described pulsating and humming tinnitus as of common occurrence both in true gout and lithæmia. Quinine and salicylate of soda have, until recently, been supposed to produce their physiological effects by causing dilatation of the cephalic vessels, and this hypothesis has derived more or less confirmation from the observations of Graefe, Roosa, and Kirchner.

Roosa² noticed, after a moderately large dose of quinine, pinkness of the optic disc and increased calibre of the vessels of the drum membrane. While not pretending to any familiarity with the use of the ophthalmoscope, I may be allowed to suggest that the presence of a pinkish tinge is hardly sufficient evidence in itself. Had it been stated that vessels, which before administration of the drug were invisible, became apparent, the case would be different. It is also well known that long continued or often repeated examination of a healthy meatus by means of a speculum is apt to produce temporary hyperæmia of the tympanic membrane.

Kirchner³ fed animals with quinine and salicylate of soda, and found, on *post mortem* examination, congestion of the middle ear and labyrinth. We do not yet know how quinine and the salicylates produce death, so that in those animals which died directly from their effects, the pathological conditions described may have been due to some change which occurred during the agony; whereas the same argument applies with perhaps greater force to those whose existence was terminated by violence. On the other hand, Grunning, Michael,⁴ and Knapp have described cases of quinine amblyopia, in which the disc was in a state of almost perfect

¹ *Lancet*, 1874.

² *Diseases of the Ear*, 516.

³ *Berlin. Klin. Wochenschrift*, 1881, 49.

⁴ *Archiv für Augenheilkunde*, vol. xi.

anæmia, the vessels being hardly perceptible. Unless, therefore, we are prepared to attribute to quinine the power of acting upon two separate vaso-motor areas in a diametrically opposite manner, we must, I think, assume that both quinine and salicylate of soda (which Knapp¹ found to produce effects similar to those caused by quinine) cause tinnitus aurium by diminishing the calibre of the labyrinthine vessels.

Nitrite of amyl, however, which in some persons produces ringing in the ears, apart from the audible pulsation of the carotids, causes hyperæmia of the retina, so much so that vessels invisible before the inhalation become afterwards well marked, as Deutschmann has observed. At the same time, it is fair to assume that the vessels of the labyrinth share the dilating influence, and that in the action of nitrite of amyl, as well as in the tinnitus of lithæmia, increased calibre of the vessels of the internal ear is the cause of the symptom in question.

Mr. Field² mentions the increased arterial tension of Bright's disease as a common cause of tinnitus. Any obstruction in the venous circulation may produce it, as for instance the pressure of an enlarged gland, or of a tight collar upon the veins of the neck.³ Woakes mentions congestion of the portal system as a possible if not a frequent cause.⁴ Whether subjective auditory phenomena may not often arise from atheroma of the labyrinthine vessels is a question which requires for its elucidation further clinical research. We have already seen that both increased and diminished action of the heart may produce the symptom in question, as exemplified by the occurrence of singing in the head after

¹ Græfe's *Archiv* xxvii.

² *Diseases of the Ear*, chap. xiv.

³ Von Trötsch, *op. cit.* 561.

⁴ *Op. cit.* 161.

a moderate dose of alcohol, and as a premonitory symptom of syncope.

While believing that tinnitus aurium may be, and very often is, caused by murmurs originating in large vessels in the neighbourhood of the ear, it is yet difficult to avoid the conclusion that the labyrinthine circulation is more frequently the principal cause. This opinion is confirmed by recent observations on the cephalic bruit of anæmia by Monsieur Tripier,¹ whose researches have been discussed and criticised by Dr. Gibson.² From a perusal of Tripier's cases, it will be seen that tinnitus was usually experienced by those patients in whom the stethoscope detected the cephalic murmur, but that it generally disappeared before the bruit ceased to be audible to the auscultator. Through the kindness of Drs. Brakenridge, Gibson, and Douie, I have been enabled to examine a number of patients in whom the cephalic bruit was present, and have found that the sound perceived by the patient is either rushing or hammering, *i.e.* venous or arterial. In some cases the tinnitus is only present after the patient has retired to rest, while the murmur can be detected in the upright posture.

It seems therefore a justifiable conclusion from these facts, that the tinnitus of anæmia is not altogether or even chiefly due to the murmurs produced in the large vessels, but probably owes its origin to conditions affecting the circulation of the internal ear. Chlorosis is in all probability a much more common cause of this distressing symptom than is generally supposed. Indeed, in the comparatively few cases I have had an opportunity of examining, it was rarely absent.

In 1874, Moos,³ relying upon data derived chiefly

¹ *Revue de Med.* 1881.

² *Brit. Med. Journ.* 1882.

³ *Archiv. of Ophth. and Otol.* 1874.

from the *post mortem* examination of a patient who was said during life to suffer from auditory hallucinations, and whose external auditory passages were filled with wax,—a condition usually considered capable of producing tinnitus,—suggested that many cases of subjective auditory phenomena may be due to an abnormal condition of the jugular bulb, such as existed in this case. Rüdinger disputed these conclusions, and pointed out that the anatomical condition described by Moos was not uncommon.

In the light of our present knowledge of the cephalic murmur of anæmia, we should expect that, when a sound, loud enough to be heard by the patient, is produced in the large vessels near the ear, it would also be audible by means of the stethoscope to the physician.

Treatment.—In the preceding pages I have endeavoured to give as full a description of the various causes of tinnitus as possible. Many of the conditions discussed do not belong to the domain of otology proper, and to consider their treatment in this work would be out of place. In those forms which owe their origin to conditions of the ear, the exact pathological lesion should, if possible, be discovered and treated. Numerous cases are, however, met with in which this is impracticable, and we must be content to palliate the distressing symptom as best we can.

If the noises be intermittent in an ear which is the seat of pathological changes (which are unlikely to vary), it may be concluded that the latter are not the only cause. The condition of the labyrinthine circulation must then be studied, and perhaps it may not be amiss to throw out a few suggestions on this point. If there be signs of congestion in the middle ear, the assumption of a similar condition in the labyrinth may form our

basis of treatment, and the application of a leech over the mastoid may afford relief. Quinine or salicylate of soda would also on theoretical grounds—founded on observations of quinine amblyopia—form a rational means of treatment, but great care and discretion must be exercised in the administration of these drugs.

If there be general anæmia, the exhibition of iron in the form of Blaud's pills is indicated, while weakened circulation and pallor of the face may justify the use of nitrite of amyl, as suggested by Michael; or better, the administration of nutritious diet in which wine forms an item.

If the nervous system be hyperæsthetic, the bromides, upon which Dr. Buck places much reliance,¹ may be given; but it has always appeared to me of questionable propriety to give general sedatives, the action of which can be but palliative. The hydrobromic acid recommended by Dr. Woakes has not in my hands proved successful even in cases of pulsating tinnitus.

It has been already stated that some forms of tinnitus are relieved by pressure on the mastoid or on the seventh cervical vertebra. Sedative or stimulant applications to these parts may be used, for we cannot be certain whether the results produced by pressure are due to its excitant or sedative action. Blowing upon the meatus, as suggested by Weil, may also be tried. Exhausting the air in the external auditory canal by suction, even when all other treatment of the ear has failed, may produce temporary relief. Instillations of glycerine to which a few drops of some sedative (*e.g.* liquor opii sedativ.) have been added, or the insertion of a plug of wool, medicated with a mixture of glycerine and chloroform, may be tried. The inflation by Valsalva's method of the steam of hot water, to which a few drops of

¹ *Diagnosis and Treatment of Ear Disease*, p. 195.

chloroform, acetic, or sulphuric ether have been added, may prove serviceable. The use of the interrupted current (Field) and also of the constant battery have been followed by good results. In the latter case, the anode is applied to the ear while the kathode is held in the opposite hand. As a general rule, however, it may be said that the prognosis of tinnitus aurium—due to ear disease—depends upon the curability of the latter, a question which must be decided upon the lines laid down in preceding chapters. Change of air and enlivening society are often of great importance, as they not unfrequently prevent the patient from brooding over his symptoms. It is also often desirable to explain to the sufferer that the symptom—troublesome and distressing as it is—is due merely to a local condition of the ear and not to brain disease, as so many people imagine it to be.

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CHAPTER XV.

DISEASES WHICH AFFECT THE EAR.¹

OWING to the large scope of the subject it is proposed to discuss, and the great amount of literature involved, it is extremely difficult to give anything like a complete *resumé* of our present knowledge concerning diseases which affect the organ of hearing; yet it is hoped that the following pages may prove useful to the practitioner, by giving in a condensed form a review of at least a portion of the literature.

*Measles and Scarlatina.*²—In both of these exanthems the ear is liable to be attacked. In the former a catarrhal affection of the middle ear is said to be common; but every practitioner engaged in the treatment of ear disease will find a large number of patients who suffer from chronic suppuration of the tympanum, which dates from an attack of measles. The catarrh may be confined to the Eustachian tubes, or it may spread outwards and involve the middle ear, without in all cases causing pain.

According to Wendt, suppuration of the middle ear

¹ Re-written from a paper by the author (*Edinburgh Medical Journal*, 1882).

² Ziemssen's *Encycl.* vol. ii. Thomas, pp. 95, 221, 277. *Lehrbuch der Ohrenheilkunde*, by Von Tröltsch, 107, 531. Bürckhardt Merian, 'Ueber Scharlach in seinem Beziehungen zum Gehörorgan abstracts,' *Archiv für Ohrenheilkunde*, xvi. 291, also *Zeitschrift für Ohrenheilkunde*, ix. 283. Politzer, *Lehrbuch*, vol. ii. p. 811.

is the most common complication in scarlet fever, and the symptoms appear either during the existence of the rash, or immediately after its cessation. In these cases the pain is violent, accompanied by febrile exacerbations and sometimes brain symptoms.

Bürckhardt Merian found that aural symptoms in scarlatina generally appear during desquamation, and consist of febrile disturbance, chilliness, earache and deafness, all of which are more or less relieved when a flow of pus has become established. The lymphatics in the neighbourhood of the auricle are, according to this author, always swollen. Bürckhardt Merian is inclined to assume the existence of a diphtheritic process in the tympanum in severe cases. It is still an open question whether the middle ear is attacked by an extension of inflammation from the pharynx, or whether the tympanum itself is a favourite point of attack selected by the scarlatinal poison.

As panotitis, Politzer describes a suppurative inflammation of both tympanum and labyrinth, which occurs in so-called scarlatinal diphtheria. Absolute deafness which is not recovered from, and vertigo which eventually disappears, are the most characteristic results of this serious complication.

Von Tröltsch has observed both otitis externa and inflammation of the membranous labyrinth as a result of scarlet fever. It is also stated that the temporal bone is sometimes primarily attacked, and that without implication of the auditory apparatus proper.

Variola.¹—According to Wendt, the eruption is often found in the neighbourhood of the faucial opening of the Eustachian tube. The same author made the

¹ Ziemssen's *Encycl.* vol. ii. p. 361. Curschman *On Small-pox*. Von Tröltsch, *op. cit.* 107, 381, 385, 531. Politzer, *op. cit.* 813.

following observations from an examination of the bodies of those who had died of small-pox :—

(1.) Pustules are met with only in the cartilaginous portion of the meatus, and most frequently near the orifice. Their presence may, however, cause swelling and hyperæmia in the osseous portion of the canal.

(2.) The middle ear was normal in only nineteen per cent. of cases. In the remainder he found either a serous exudation, alone or mixed with blood, or an accumulation of mucus, muco-pus, or pus.

Moos has described a case, in which suppuration, both of the middle ear and labyrinth, occurred—the panotitis of Politzer.

Diphtheria.¹—This disease may involve the external or middle ear, and probably also the labyrinth. Diphtheritic inflammation of the meatus is characterized, according to Gruber, by the formation of a false membrane in the canal, and by the fearful unremitting pain which accompanies it. It is a rare affection, but has also been observed by others.

Burnett describes a variety of otitis, which often results from diphtheria, as follows: ‘In children there is often found at the termination of an attack of diphtheria, inflammation in the external ear. This rapidly extends, in some cases directly to the bone of the canal, and backwards to the mastoid process. Pain is not a prominent symptom in those inflammations which follow diphtheria, and this fact will readily distinguish them from the truly diphtheritic form of external otitis, in which the peculiar false membrane is found in the auditory canal. The form of disease now referred to is one arising from the broken-down

¹ Gruber, *Lehrbuch der Ohrenheilkunde*, p. 319. Burnett *On the Ear*, p. 269. Von Trötsch, *Lehrbuch der Ohrenheilkunde*, p. 263. *Works on Practice of Medicine*, by Bristowe and Flint.

condition of the little patient rather than a form of disease already described as the diphtheritic. In the former case the pain is not great, the swelling is considerable, and the tendency to attack bone is marked. Fluctuation is soon felt over the mastoid region, and after evacuation of pus, the bone beneath is felt denuded, and in some cases crumbling.'

Acute otitis media, which may and often does become chronic, is a common accompaniment of diphtheria. In this disease—as in scarlatina and variola—the labyrinth may be attacked. Wendt found that in a large proportion of cases the cartilaginous portion of the Eustachian tube was filled or lined by false membrane, while in one case only was he able to trace the diphtheritic process into the tympanum. This fact seems to me strong evidence against the views of Bürckhardt Merian¹ regarding the common occurrence of a diphtheritic inflammation of the tympanum in severe cases of scarlatinal otitis. The occurrence of deafness due to post-diphtheritic paralysis is mentioned by writers of medicine, but has not yet attracted the attention of specialists. When impairment of hearing due to this cause does occur, it is not improbable that the actual lesion is to be sought in paresis of the tensor tympani and stapedius. This has, I believe, been pointed out by Hughlings Jackson.

*Mumps.*²—That parotitis may give rise to marked deafness is a fact which has been well known for years past to English aurists. Toynbee and Hinton were

¹ *Op. cit.*

² Toynbee, *Diseases of the Ear*, p. 361. Hinton, *Questions of Aural Surgery*, p. 263. Roosa, 'Diseases of the ear occurring during the course of parotitis,' *Archives of Otology*, 1883. Brunner, 'Case of complete unilateral deafness after mumps,' *ibid.* 1882. Moos, 'A case of double labyrinthine affection, with staggering gait and permanent abolition of hearing after mumps,' *ibid.* 1882. 'A case of bilateral deafness after mumps,' *ibid.* 1882.

also well aware of the fact that in such cases the labyrinth is often incurably injured. Quite recently numerous cases have been recorded—by Knapp, Moos, Brunner, and others—which, however, only serve to confirm the observation made by Toynbee years ago, that the deafness which follows mumps is often due to an affection of the labyrinth (the exact nature of which remains unknown), and that both ears are sometimes affected, but usually only one.

Vertigo seems to be often complained of, but passes off, while deafness usually persists. Ten cases observed by Roosa seem to show that inflammatory changes occur in the middle ear as well as in the labyrinth.

Typhus.¹—Toynbee recorded several cases in which the labyrinth or auditory nerve were permanently incapacitated after recovery from this disease. Recently Hartmann examined a number of convalescents, and found that out of 130 patients, 36 had ear affections, besides six in whom the meatus was filled with wax. The lesions as recorded by him were as follows:—

Catarrh of the Eustachian tubes and tympana,	14
Acute otitis media with intact membrane,	4
Acute otitis media with perforation,	9
Increase of previously existing tinnitus and deafness,	3
Return of a healed otorrhea,	1
Tinnitus without objective signs,	2
Disease of the labyrinth,	3

Typhoid Fever.²—During the course of this disease the ear is not unfrequently attacked. Liebermeister refers especially to affections of the Eustachian tube

¹ Toynbee, *Diseases of the Ear*, p. 360. Hartmann, *Zeitschrift für Ohrenheilkunde*, viii. 209.

² Ziemssen's *Encycl. Liebermeister*, 'Typhoid Fever.' Von Trötsch, *op. cit.* 383, 556. Burnett, *op. cit.* 593.

and middle ear as being common. Hoffmann met with perforation of the tympanic membrane in a considerable number of cases. According to Schwartz, deafness occurring in the course of typhoid may be due to—(1) suppuration of the middle ear, (2) pharyngeal catarrh extending towards the tympanum by way of the Eustachian tubes, or (3) central nervous disorders. Moos has demonstrated — *post mortem* — in several cases a cellular infiltration of the membranous labyrinth. Politzer found ecchymosis in the labyrinth in two cases, and Schwartz congestion of the cochlea in one instance.

*Relapsing Fever.*¹—So far as I am aware, the only observation on this point is contained in a paper on ‘Ear and Eye Affections in the course of relapsing Fever,’ by Dr. Luchau. This author found that acute inflammation of the tympanum occurred in fifteen out of a hundred and eighty cases. He also states that in only one of these was there any evidence of pharyngeal catarrh, so that the assumption is justified, that relapsing fever occasionally attacks the tympanum—not by extension of inflammation from the throat, but directly.

*Epidemic cerebro-spinal meningitis.*²—Speaking of this disease, Von Trötsch says: ‘One of the commonest complaints of the patient at the beginning of the attack is of tinnitus; sometimes earache and auditory hallucinations set in, and very often more or less marked

¹ Virchow's *Archiv*, vol. lxxxii. p. 18.

² Von Trötsch, *op. cit.* pp. 536, 537. Ziemssen's *Encycl.* vol. ii. pp. 724–26. Burnett *On the Ear*, 564. Roosa, *Diseases of the Ear*, p. 532. Gottstein, *Archives of Otology*, vol. ix. p. 255. Moos, *Meningitis Cerebro-spinalis epidemica*. Politzer, *Lehrbuch der Ohrenheilkunde*, vol. ii. 850. Moos, *Ueber die histologischen Veränderungen des Labyrinths bei der hämorrhagischen Pachymeningitis*. *Zeitschrift für Ohrenheilkunde*, ix. 97. On the formation of a new membrane in the drum cavity resulting from hæmorrhagic pachymeningitis, Moos and Steinbrügge, *Archives of Otology*, vol. xi. 97. ‘Hæmorrhagic Pachymeningitis,’ etc., *ibid.*, by Moos and Steinbrügge, 322.

impairment of hearing, which often goes on to complete deafness.' Deafness is generally bilateral, more rarely unilateral. Von Trötsch believes that in many cases this symptom is due to changes in the floor of the fourth ventricle. Ziemssen, however, while not denying the occurrence of a lesion in this situation, states that his clinical experience is against this view.

I shall now mention the morbid conditions which have been observed in the ears of those who have suffered from cerebro-spinal meningitis.

(1.) Acute suppuration of the middle ear is not uncommon, and Ziemssen has noticed its occurrence about the twenty-fifth day of illness.

(2.) Congestion and purulent infiltration of the labyrinth.

(3.) Compression and purulent infiltration of the auditory nerve. These two last-named conditions are found either together or separately.

Roosa states that from the *post-mortem* examinations which have been made, it seems that the labyrinth is the part most affected, and he also calls attention to the well-known absence of facial palsy in the majority of cases. Burnett believes that as the arachnoid fluid is continuous with the endo and perilymph, it is probable that the inflammation thus extends to the labyrinth, especially as arachnitis is a marked feature of the disease. Deafness may come on at any stage, but according to Ziemssen and Hesse it most commonly begins on the third day. The latter writer hesitates to decide between two theories as to the causation of suppuration in the labyrinth, and thinks it may be due either to extension along the nerve, or to the internal ear being affected simultaneously with the pia mater.

It has been noticed by many writers on ear disease that children are occasionally attacked by symptoms

of cerebral irritation, are laid up for a few days, and eventually after recovery are affected with deafness, and stagger as they walk. The etiology of these symptoms is still a matter of doubt. Voltolini ascribes them—without adducing pathological proof, however—to primary inflammation of the labyrinth. Gottstein, on the other hand, makes out a very strong case against Voltolini's theory, and considers that the majority of such cases are in reality mild or aborted attacks of cerebro-spinal fever. Between March and October 1879, Gottstein had under his care twenty-five cases of what Voltolini describes as otitis labyrinthica, out of a total of 250 patients.

'The very fact,' he goes on to say, 'that so large a proportion of cases of otitis labyrinthica (ten per cent.) were among the cases of ear disease which came under my care during the above period must of itself create surprise. If I exclude six which date a year or more back, there are nineteen cases between December 1878 and August 1879; seven of these came from Breslau, and four from more distant districts. This remarkable coincidence of the same affection in time and place seemed to be no mere chance, and I could not help thinking of an epidemic. The only case under regular medical treatment from the first was diagnosed as cerebro-spinal meningitis. In one other case, however, an epidemic of cerebro-spinal meningitis could be assumed, because the symptoms were typical of the disease; and secondly, because five children (two of whom became deaf) were attacked with the same disease in the same village.' Gottstein then gives the histories of several cases, and seems to prove them to have been in reality cerebro-spinal fever, and finally sums up his conclusions as follows: 'Out of nineteen cases we have found six in which meningitis could

probably be regarded as the starting-point of Menière's complex of symptoms. In the thirteen remaining cases feverishness and violent headache were present; vomiting was not observed at first in two cases; the mind was more or less affected in nine; in three, fever, headache, and vomiting were the only symptoms preceding the affection of the ear. The patients, with one exception, belonged to the lower classes, and lived amidst bad sanitary conditions; their ages varied between two and sixteen. If we take all these points into consideration, and add that an epidemic of cerebro-spinal meningitis had raged in Breslau and Silesia since last autumn, we have no hesitation in connecting these cases of auditory vertigo with feverishness and other peculiar symptoms, with this epidemic.'

Permanent deafness is a very common sequel of cerebro-spinal meningitis. It is almost always bilateral and absolute. Ziemssen gives some very startling facts on this subject. In the deaf-mute institution at Bamberg there were, in 1874, forty-two pupils, all of whom owed their affliction to this cause. In a similar establishment at Nuremburg, the number of pupils was thirty-two, and of these two-and-twenty had become deaf after cerebro-spinal fever. In some few cases gaps in the hearing power have been noticed, *i.e.* ability to hear some notes but not others. After recovery the patient often has a staggering walk, like a sailor's roll. Out of twenty-four cases of cerebro-spinal meningitis observed by Fasset in Philadelphia, twelve recovered, three remained totally deaf, and one partially so. In a very interesting monograph on cerebro-spinal meningitis, with special reference to subsequent deafness and loss of equilibrium, Moos arrives at the following conclusions:—

- (1.) That Voltolini's cases of primary inflammation

of the labyrinth were in reality mild cases of epidemic meningitis.

(2.) In those cases where staggering remains after convalescence it generally disappears before the twenty-seventh month.

(3.) In those cases where labyrinthine deafness comes on between the third and tenth day of illness, the labyrinth is involved by becoming in itself the seat of inflammatory changes; whereas, when deafness begins on or after the fourteenth day, the internal ear has become involved by extension of inflammation along the auditory nerve.

(4.) Those who are able to hear high notes have a better chance of recovering hearing than those who cannot.

(5.) In cases of absolute deafness without tinnitus, the occurrence of this symptom is favourable, as showing a tendency in the auditory nerve to resume its function.

The above is but a brief *resumé* of the most striking points in Moos's work; but the reader who is interested in the subject should study the original monograph, which is probably the most complete essay existing on the subject.

In non-epidemic meningitis the auditory nerve, its centre or the internal ear, may also become involved during the inflammatory process. Politzer has noticed that in children deafness from this cause is usually complete, while adults usually retain a certain amount of hearing power. In these cases a staggering gait may persist for some months. Before leaving the subject of meningitis, I must here allude to the recent observations by Moos and Steinbrügge on ear lesions occurring in the course of hæmatoma of the dura mater. These authors found that extravasations of blood occur into the labyrinth and the substance of the auditory nerve in the course of this disease, while in one case an

adventitious vascular membrane of a red colour, in which numerous small extravasations were seen by the microscope, was found in the tympanic cavity.

*Whooping Cough.*¹—This, according to Roosa, is a common cause of acute ear disease, and probably also of chronic catarrh. During paroxysms of cough, the membrane has also been known to rupture with or without hæmorrhage from the ear.

*Malaria.*²—The relation of malaria to ear disease has been pointed out by Weber Liel and Voltolini. The former has described several affections which he considers due to malaria, and curable by quinine.

Otalgia intermittens, or intermittent aural neuralgia, appears, from descriptions given by these authors, often to arise in an ear which is already the seat of catarrh. The symptoms consist of violent pain at night, with diurnal intermissions.

Weber Liel also describes an otitis intermittens which is often preceded by pharyngeal catarrh. Its symptoms are rigors more or less marked, occurring at night and followed by perspirations; the ear is at the same time affected, and pain is generally complained of on the second attack of ague. Eventually perforation of the membrane occurs, followed by otorrhea. During the day pain and otorrhea both diminish only to return again at night, until at last the disease becomes confirmed and loses its intermittent character. Dr. Hotz of Chicago has to a very great extent confirmed these views, and describes a number of typical cases. He lays great stress upon severe subjective symptoms, with comparatively slight objective signs as features of malarial otitis.

¹ Roosa, *op. cit.* 353. Von Tröltsch, *op. cit.* 147.

² *Monatsschrift für Ohrenheilkunde*, 1878. *Zeitschrift für Ohrenheilkunde*, vol. ix.

Another form of ear disease modified by ague, Weber Liel illustrates by the following case. An old lady was suffering from tinnitus aurium and deafness, which were both temporarily relieved by the air douche, but always returned again with increased severity at night; in this case the use of quinine was followed by considerable improvement.

*Treatment of ear affections which occur in the course of acute diseases.*¹—It is not my intention to discuss at length either the prognosis or treatment of the ear affections which have been described. The practitioner's knowledge of general medicine will aid him in so modifying the rules which have been previously laid down as to adapt them to each case. There is, however, one point to which it is necessary to allude further. In an earlier chapter it was recommended, if possible, to treat acute inflammation of the tympanum without incision of the drum membrane. This in no way applies, however, when the affection is due to one of the exanthemata; for in them there appears to be not only a tendency for the pus to become evacuated, but also for the membrane to ulcerate, so that often a very large amount of tissue is actually lost. This result may in many cases be prevented by incision. If the general condition of the patient does not stand in the way, the first signs of bulging on the part of the membrane should be met by artificial evacuation.

*Gout and rheumatism.*² — Toynbee ascribed the presence of exostoses in the meatus in many cases to a rheumatic or gouty diathesis. Our modern textbooks, however, with the exception of those by Gruber

¹ Compare Hinton, *Questions of Aural Surgery*, p. 133.

² Toynbee, *Diseases of the Ear*, pp. 108, 281, 362. Gruber, *Lehrbuch der Ohrenheilkunde*, p. 413. Macnaughton Jones, *Aural Surgery*, pp. 17, 18. Flint, *Practice of Medicine*, p. 1029. Hinton, *Quest. of Aural Surgery*, pp. 67, 93. Pritchard, *Transactions of the International Congress*, 1881.

and Macnaughton Jones, do not seem to indorse this view. At the International Congress of 1881, Dr. Urban Pritchard expressed his belief in the accuracy of Toynbee's views. One of his arguments was founded on the fact that in practice this form of ear disease is much more commonly met with among the better classes than among hospital patients. My own experience fully bears out this observation. Garrod, as is well known, has described deposits of urate of soda crystals occurring in the auricles of gouty persons. According to Hinton, 'there is no form in which a gouty affection of the ear is so clearly marked as in a peculiar obstinate irritability of the meatus, attended with slight serous or sticky discharge with itching and pricking pain, the walls being somewhat swollen, with a tendency to purple in their redness. In these cases the membrane also is congested, but the structures of the tympanum may apparently scarcely be involved.' This condition is said also to resist purely local treatment.

Anchylosis of the stapes in the fenestra ovalis is said by Toynbee to be most common in those who have a tendency to gout or rheumatism. Dr. Buckler, in a work published in 1853, refers to the occurrence of anchylosis between the ossicles in rheumatism. Unfortunately, I have been unable to obtain his treatise, and cannot therefore tell on what data this statement is founded. That diseases which attack joints elsewhere are likely at times to involve those of the ossicles, seems in the highest degree probable—more probable, indeed, than is admitted by modern writers on otology.

Toynbee observed a very peculiar group of ear symptoms which he traced to gout, in which a feeling of vacancy in the ear and humming tinnitus, temporarily relieved by plugging the meatus, were complained of. A cure was effected by local depletion (leeching),

restricted diet, and small doses of colchicum. The example of rheumatic inflammation of the auditory nerve observed by Bing has already been referred to.¹

*Syphilis.*²—The auricle may become infiltrated with gummatous deposits, which may break down and ulcerate. Hinton, Schwartz, and others have noticed the occurrence of syphilitic ulceration in the external auditory meatus. The ulcers are annular, with a dirty white base and swollen edges, which encroach upon the lumen of the canal, while the adjacent lymphatics are often enlarged. Von Tröltsch describes a painful form of otorrhea which is caused and kept up by the presence of condylomata, and similar cases too have been described by Buck. Lacharrière has observed a form of acute syphilitic otitis externa which he considers pathognomonic. The walls of the meatus are swollen, but not so much as in the phlegmonous form; the skin is cracked and red, while the discharge is very offensive. Both canals are usually attacked simultaneously. I have seen a case which coincided with this description in all particulars save one. Both canals were attacked, but there was no disagreeable odour.

Von Tröltsch states that acute catarrh of the middle ear often sets in very suddenly in syphilitic patients. Roosa is of opinion that syphilis produces a tendency to proliferation of tissue in the tympanum, and agrees with Schwartz that this is primarily due to a periostitis. My own experience leads me to believe that a specific taint so intensifies the progress of chronic non-suppurative inflammation of the middle ear, that thickening and adhesions—which would otherwise take

¹ P. 117.

² Burnett *On the Ear*, pp. 271, 333. Hinton, *Quest. of Aural Surgery*, pp. 96, 291. Von Tröltsch, *op. cit.* pp. 114, 265. Buck, *Diagnosis and Treatment of Ear Disease*, p. 104. Roosa, *Diseases of the Ear*, pp. 238, 504. Gruber, *Lehrbuch der Ohrenheilkunde*, p. 617. Knapp, *Zeitschrift für Ohrenheilkunde*, ix.

years to form—result in a very short time. So far as I am aware, however, the onset of deafness is quite painless in the majority of cases. Occasionally the healing of pharyngeal ulcers leads to closure of the Eustachian tubes, which are also often obstructed by catarrhal swelling of the lining membrane.

Hinton believed that deafness from lesion of the terminal portion of the auditory nerve often arises at the age of puberty in those affected with hereditary syphilis. The deafness is very great, greater than in tympanic disease, and the tuning-fork is not heard by bone conduction. There is in these cases, of course, no characteristic appearance of the drum membrane.

Knapp of New York has lately observed several cases of heredito-syphilitic ear disease, in which there was a combination of middle ear catarrh and labyrinthine mischief. In obstinate cases of Eustachian obstruction occurring in children or young persons it is well to bear this in mind, and to apply the tuning-fork test with care. Should a constitutional taint exist, medication directed to this condition may materially aid local treatment. Roosa is of opinion that there are no symptoms pathognomonic of affections of the labyrinth due to syphilis, and that there is good reason for believing that periostitis and gummata occur in the internal ear, besides lesions affecting the trunk of the portio mollis.

Gruber in the *post-mortem* examination of a case of deafness, supposed to be due to syphilitic disease of the labyrinth, found the latter congested and thickened, and its fluid contents tinged with blood. Unfortunately, the patient died of typhus fever; and it seems not impossible that the congestion was in some way associated with this, although deafness had previously existed.

*Tuberculosis.*¹ — That the petrous portion of the temporal bone is liable to be attacked is shown by observations, recorded by Zanfali and Schwartz; but whether there ever occurs in the human subject a true tuberculosis of the tympanic cavity remains to be proved. This lesion has, however, been described by Schütz as occurring in the pig. He found that in this animal the disease begins as a pharyngeal catarrh, which is soon followed by cheesy degeneration of the gland structures, and finally spreads to the tympanum. In man, Schwartz has seen, both on the mucous membrane of the tympanum and on the drum head, grey nodules which presented the naked-eye appearance of tubercle; but no opportunity of microscopic examination was afforded. Suppuration of the tympanum in phthisical patients may run its course without pain, and is characterized by the rapid destruction of tissue which it produces, and the obstinacy with which it resists treatment. Von Tröltsch has observed the occurrence of such an otorrhea in tubercular patients before any evidence of a constitutional taint could be found in the lungs. Buck describes a form of tympanic inflammation which he has observed in one or two cases of phthisis. Its clinical features seem to be the presence of a solid white mass behind the drum membrane, and he designates this condition cheesy inflammation. Hinton has also noticed that the ear participates in phthisis. One condition mentioned by this author I have not seen described elsewhere, namely, a loss of function of the auditory nerve without any changes in the middle ear.

*Leukæmia.*² — Gottstein has recorded two cases where,

¹ Von Tröltsch, *op. cit.* pp. 459, 460. Schwartz, *Path. Anatom. des Ohres*, pp. 69, 99. Burnett *On the Ear*, p. 448. Hinton, *op. cit.* 67, 276. Buck, *Diagnosis and Treatment of Ear Disease*, 244, 245.

² *Archives of Otology*, vol. ix. p. 268.

in the course of this affection, deafness came on suddenly, was bilateral (in one there was an interval of a few days between the two ears), and absolute; vertigo was also marked. Both cases ended fatally, but no *post-mortem* examination was allowed. The question, therefore, remained unsolved as to whether the pathological cause lay in the labyrinth, auditory nerve, or its centre. Arguing from the analogy (hæmorrhages in the retina and from the mucous membranes, which occur in this disease), little doubt could be entertained of its hæmorrhagic nature.

*Bright's Disease.*¹—In this disease, as is well known, hæmorrhages are found in the retina. Occasionally the ear is affected in the same way. The tympanum becomes filled with blood which either becomes absorbed or leads to suppuration. Schwartze was the first to describe this condition. In a case reported by him, a dark red colour was communicated to the membrane by the blood contained in the tympanum, so that the diagnosis was easy. I am not aware that sudden labyrinthine deafness in the course of Bright's disease has been described, but it seems probable that such a contingency might be looked for here and also in pernicious anæmia, in which retinitis hæmorrhagia is not uncommon.

*Intra-cranial tumours.*²—To aneurism of the basilar artery as a cause of deafness and tinnitus reference has been made in the preceding chapter.

Calmeil found that one-ninth of all cases of brain tumour are accompanied by disordered hearing. Ladame analysed a number of cases, paying attention to the presence of auditory disturbance, and his results are as follows :—

¹ Roosa, *Diseases of the Ear*, pp. 256, 257.

² Urbantschitsch, *Lehrbuch der Ohrenheilkunde*, p. 463. Schwartze, *Path. Anat. des Ohres*. Ladame, *Symptomatologie und Diagnostik der Hirngeschwülste*. Bernhardt, *Beiträge zur Diagnostik der Hirngeschwülste*, Berlin 1881.

Number of cases.	Situation of tumour.	No. of cases of auditory disturbance.
77	Cerebellar	7
26	Pons	7
27	Middle lobes	3
27	Anterior lobes	0
14	Posterior lobes	0
4	Fourth ventricle	0

The cases collected by Bernhardt, one of the most recent authorities, led him to the following conclusions. In tumours affecting the corpora striata, optic thalami, and crura cerebri, the hearing power did not suffer; while in those situated in the cortex, ear symptoms occurred twice in fifty-seven cases. In neoplasms of the cerebral lobes diminished hearing power or subjective auditory phenomena (either on the side of the tumour or in the opposite ear) seem to have occurred in about one-eleventh of all cases. Where the growth involved the corpora quadrigemina and pineal gland, out of ten cases there was once partial and once complete deafness, while in one instance tinnitus was the most prominent symptom. Of tumours involving the pons, nearly one half produced ear symptoms. To translate the author's words: 'Generally hearing was diminished on the side corresponding to the tumour, or it was disturbed by tinnitus. Rarely was there absolute deafness. At the same time, the fact must not be lost sight of, that in several cases pathological changes were noticed in the immediate neighbourhood of the pons, and that the auditory nerve was in one case directly pressed upon.' In cerebellar tumours, Bernhardt states that the hearing is commonly affected when one of the hemispheres is the seat of disease. When the growth was situated in the medulla, deafness and tinnitus were present four times in eighteen cases.

*Apoplexy.*¹—According to Moos, deafness is not a common result of cerebral hæmorrhage. It is, however, most frequent as a consequence of unilateral extravasation into the pons.

*Pregnancy and Parturition.*²—During pregnancy, but still more commonly, immediately after labour, a pre-existing deafness, due to chronic non-suppurative inflammation of the middle ear, may suddenly get worse. This fact is probably known to all aurists, but has been especially pointed out by Roosa. Pomeroy believes that in many of these cases the labyrinth is affected either by anæmia or nervous shock. The same author calls attention to the atrophy of the optic nerve which sometimes results from childbed, and has made the interesting observation that in some cases the hearing power is immediately improved by the ingestion of nourishing food and stimulants. Cases amenable to this form of treatment should be considered as analogous in nature to the nervous or functional form of deafness described in an earlier chapter. Toynbee has recorded a 'well-marked and characteristic case of a lady who became deaf after each confinement.' At first this only lasted for a short time, disappearing as the patient gained strength, but eventually after the birth of her last child it remained permanent and absolute.

*Neuralgia of the Ear.*³—Neuralgia sometimes attacks the ear, but rarely does so unless it be in the form of reflex pain. When present it must be met on the same therapeutic lines which apply to the condition when situated in other parts.

Gerhardt has stated that ulceration of the epiglottis

¹ Moos, *Klinik der Ohrenkrankheiten*, 1866.

² Roosa, *Diseases of the Ear*, p. 286. Pomeroy, *Diseases of the Ear*, p. 371. Toynbee, *Diseases of the Ear*, p. 370.

³ Von Tröltsch, *Lehrbuch der Ohrenheilkunde*, p. 568. Ziemssen, *Handbuch der Krankheiten des Respirations apparatus*, 371.

is usually accompanied by pain in the ear. This so far I have been unable to confirm. Ziemssen believes that, under certain circumstances, pain radiating towards the ear is of value as confirming the malignant nature of laryngeal neoplasms. Thus out of thirteen cases of malignant disease in the larynx, pain in the ear was experienced in nine.

A very common cause of earache is to be found in the presence of carious teeth or stumps, which produce a reflex aural neuralgia. While not denying that neuralgic pain in the ear may be due to malarial poison or other causes, yet in a climate such as ours earache without inflammation of the meatus or middle ear, and unaccompanied by throat symptoms, will generally be found to owe its origin to this cause. Very often in these cases there is a history of toothache, which may be no longer present. Generally the pain is strictly localized in the ear at first; frequently, however, it spreads and attacks not only the whole area supplied by the fifth nerve, but also the occipital or mammary regions.

*Locomotor Ataxia.*¹ — Erb found atrophy of the auditory nerve in some cases, while Pomeroy and M'Bride consider progressive deafness in locomotor ataxia to be common. The latter observed impairment of hearing, which was sometimes transitory, in every case he examined.

*Hysterical affections of the ear.*² — Writing on this subject, Burnett says: 'Dr. T. Weir Mitchell has called my attention to what he terms hysterical deafness.

¹ Schwartze, *Path. Anatomie des Ohres*, p. 123. Pomeroy, *Diseases of the Ear*, p. 363.

² Burnett, *Diseases of the Ear*, p. 495. Urbantschitsch, *Lehrbuch der Ohrenheilkunde*, p. 484. Walton, *Deafness in hysterical hemianæsthesia Brain*, vol. v. 458. Weber Liel, 'Ueber den Einfluss sexueller Irritationen auf Affectionen des Gehörorgans,' *Monatsschrift für Ohrenheilkunde*, Sept. 1883.

In the case of a young woman he observed a deafness which would apparently come and go during conversation. At other times the patient would fail to hear under circumstances in which she had but a short time before appeared to hear well.' Urbantschitsch has recorded an interesting case in which there was total anæsthesia—including deafness and blindness—on the left side, and in which the phenomenon of transfer was well marked after the application of a small magnet to the left mastoid process. Sudden emotion and the use of nitrite of amyl were also in this instance followed by transfer. More recently Walton, in an elaborate article on Deafness in Hemianæsthesia, has arrived at the following conclusions:—

‘1. The sensibility of the deep parts of the ear, including the tympanum and middle ear, disappears in hysterical hemianæsthesia, with that of other parts of the body and in the same degree.

‘2. The degree of deafness corresponds with that of the general anæsthesia, being complete when the latter is complete, and incomplete when the latter is incomplete.

‘3. When the loss of hearing is incomplete, the deafness for sounds conveyed by the bone exceeds that for sounds conveyed by the air.

‘4. When the transfer is made, the hearing, as well as the general sensibility of the deep parts of the ear, improves on one side (allowance being made for accidental lesions in the ear itself) in exactly the same degree in which it disappears on the other.’

As hysterical we must also consider a form of ear affection described by Weber Liel. It is characterized by deafness and tinnitus, and occurs as a complication of uterine or ovarian disorders. Both impairment of hearing and tinnitus are said to disappear after elec-

trical treatment—the anode being introduced into the Eustachian tube, while the cathode is applied to the lower dorsal or upper lumbar vertebræ. The same author records the case of a lady who suffered from ovarian pain, accompanied by distressing tinnitus, which was only relieved by the application of an ice bag to the region of the painful ovary.

APPENDIX.

—o—

ALTHOUGH it is impossible in a small work to describe all the instruments, with their various modifications, which have been employed in the diagnosis and treatment of Ear Disease, yet it is hoped that the list appended will meet the probable requirements of the general practitioner. The accompanying drawings are not full-sized, but range from one-half to three-quarters of the size of the instrument from which they were copied.

PLATE I.

A. Hand-mirror or reflector.¹ In using it the reflecting surface should be directed towards the source of light, and held about five inches from the ear, while the examiner looks through the central aperture with one eye.

B. The same attached to a forehead band, which is necessary when both hands of the surgeon are required, as, for instance, in operating.

PLATE II.

A. Politzer's air-bag. The pointed extremity is made to fit into the wide opening of the Eustachian catheter, so that air may be driven into the latter instrument when it has been placed in position.

Some surgeons prefer to have the catheter connected with the bag by means of a tube, but this is merely a matter of detail.

¹ The appliances here recommended are kept in stock by Mr. Gardner, Surgical Instrument Maker, 45 South Bridge, Edinburgh.

B. Nozzle of the air-bag with a piece of soft rubber tubing drawn over it. This is required when the bag is used without the catheter to prevent injury to the nostril. Instead of this simple appliance many special apparatus have been invented, the best being that figured at C.

C. Allen's nasal pads. When these are used it is only necessary to lay the perforated pads over the nostrils without compressing them, as the escape of air is thus effectually prevented.

D. Auscultating tube by means of which the ear of the observer is connected with that of the patient during inflation.

E. Eustachian catheter (vulcanite). The surgeon should have at least three different sizes, and great care should be taken to cleanse the instrument after use. A safe plan is to keep the catheters in a solution of carbolic acid (1-40) after having washed them in an alkaline lotion to dissolve away adherent mucus.

F. Siegle's pneumatic speculum. The instrument is composed of vulcanite, and the extremity which is meant for insertion into the meatus (*a*) is movable, and can be replaced by an ear piece of different calibre; attached to the speculum by a tube is seen a small soft rubber bag (*b*), used for alternately compressing and rarefying the air within the speculum.

G. The same, showing the plate of glass (*c*) stretching obliquely across the outer end.

H. Small syringe, with a vulcanite nozzle used for injecting fluid into the middle ear through the catheter. A few drops are injected into the instrument, and then forced onwards by means of the air-bag.

PLATE III.

A. Tuning-fork. The fork used should be of considerable size, and it is useful to have on its branches two movable brass clamps. As these are moved downwards towards the stem the note becomes higher, as pointed out by Politzer.

B. Silvered specula as used by Gruber (four sizes).

C. Angular forceps.

D. Handle to which can be attached (at will)—

(a) Gruber's paracentesis knife for incising the membrane.

(b) Polypus snare threaded with wire and ready for use.

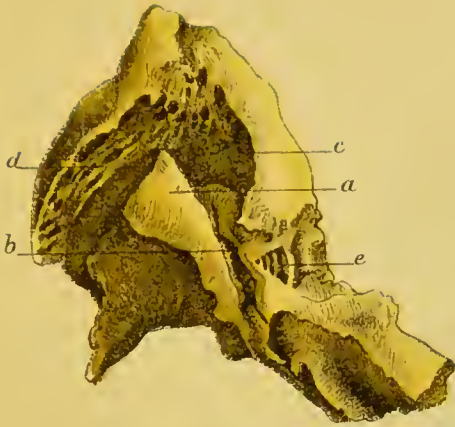
(c) Probe.

It is well to have such instruments attached at an angle to the handle, in order that the operator's hand may not interfere with his view.

E. (a) Blunt hook. (b) Sharp hook. Both instruments are used for extracting foreign bodies, the latter more especially in the case of soft substances.

F. Strong bent forceps used by Politzer for crushing polypi which cannot otherwise be extracted.





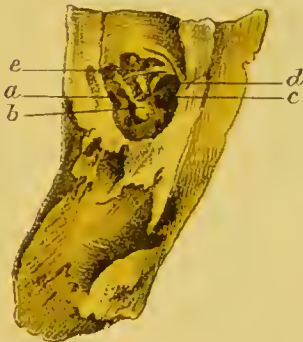
(A.)

(a) The osseous portion of the Meatus dissected out by means of a chisel, (b) Tympanum, (c) Mastoid antrum, (d) Mastoid cells, (e) the Cochlea opened into.



(B.)

The Tympanum laid open by removing the roof, showing (a) Head of Malleus, and articulating with it posteriorly, (b) the body of the Incus, (c) the Tensor Tympani muscle, (d) the tendon of the same.



(C.)

In this dissection the whole Tympanic membrane has been removed, showing (a) Tympanic ring, to which the membrane is attached in the recent state, (b) Manubrium, or handle of the Malleus, (c) niche of the Fenestra rotunda, (d) long process of the Incus, incudo-stapedial joint and posterior ramus of the stapes, (e) Chorda Tympani nerve.



(D.)

Inner wall of the Tympanum. (a) Facial nerve, the osseous covering having been removed, (b) the stapes in position showing the head and rami (c) the promontory. (d) the niche of the Fenestra rotunda, (e) the stapedius tendon.

natural size from dissections in the possession of the author.



Drawn by permission from a specimen in Professor Turner's collection. (a) Catheter hooked round the nasal septum, (b) opening of Eustachian tube, (c) the nasal septum.



Drawn by permission from a specimen in Professor Turner's collection. Eustachian catheter in position. (a) Posterior prominent margin of Eustachian Orifice.



Normal drum membrane (right ear) showing (a) the handle of the Malleus, (b) the shining spot, (c) the Membrana flaccida. The upper part of the Malleus is the short process (d).





(A.)

Membrane in acute inflammation of the middle Ear. The vessels are much injected, and the outline of the Malleus (with the exception of the short process) is obscured (right ear).



(B.)

A more advanced stage of acute inflammation of the middle Ear, in which the Malleus is entirely lost to view, and the epidermis is raised in white flakes by serous exudation (right ear).





(A.)

A perforation in the anterior and lower part of the membrane, showing the congested lining membrane of the Tympanum (left ear).



(B.)

A thin transparent cicatrix in an indrawn or concave membrane, showing (a) the marked posterior fold, (b) the prominent short process, (c) the cicatrix, which might be taken for a perforation but for the result produced by inflation, as shown in the next drawing. (right ear).



(C.)

The membrane shown in the preceding drawing, after air has been forced through the Eustachian tube. The whole membrane is injected and forced outwards. The prominent posterior fold has diminished, and the cicatricial tissue (being the thinnest and most yielding portion) is blown out into a convex bladder-like projection. (right ear).



(D.)

A cicatrised and atrophied membrane showing deposits of chalk on either side of the Malleus. (left ear)



(E.)

A somewhat large polypus which when touched with a probe was freely movable. The colour is similar to this in polypi and granulations, while the size may vary from a pin-head to a cherry. Exceptionally large growths when they project from the Meatus are covered by mucous membrane, more nearly approaching the colour of the skin.





(A.)

Membrane characteristic of obstruction of the Eustachian tube. (a) Projecting short process, (b) marked posterior fold, while corresponding with it, in front, is the prominent but less marked anterior fold, (c) region of the Membrana flaccida drawn inwards, (d) lower portion of the Malleus and Membrane sucked inwards.

The indrawn parts are, of course, further from the observer. (right ear).



(B.)

Membrane, the posterior portion of which is atrophied, and therefore unduly transparent, showing (a) the head of the stapes and its anterior ramus, (b) the niche of the Fenestra rotunda. (right ear).



(C.)

The same membrane after inflation, showing the most atrophied and yielding portion. (opposite the Fenestra rotunda), driven out in a bladder-like convexity.



(D.)

Showing the appearance produced by the presence of serous fluid behind a transparent drum membrane. The dark line is the upper margin of the fluid, and changes its position as the head is moved. (right ear).



(E.)

The same after air has been driven through the Eustachian tube. Bubbles are seen behind the membrane, and the hair-like line of demarcation is lost.



(F.)

A thickened membrane showing patches of opacity varying in degree. This condition is difficult to portray, as the lustrous opacity really seen cannot be represented in water-colours. (right ear).



